

# Topic 3

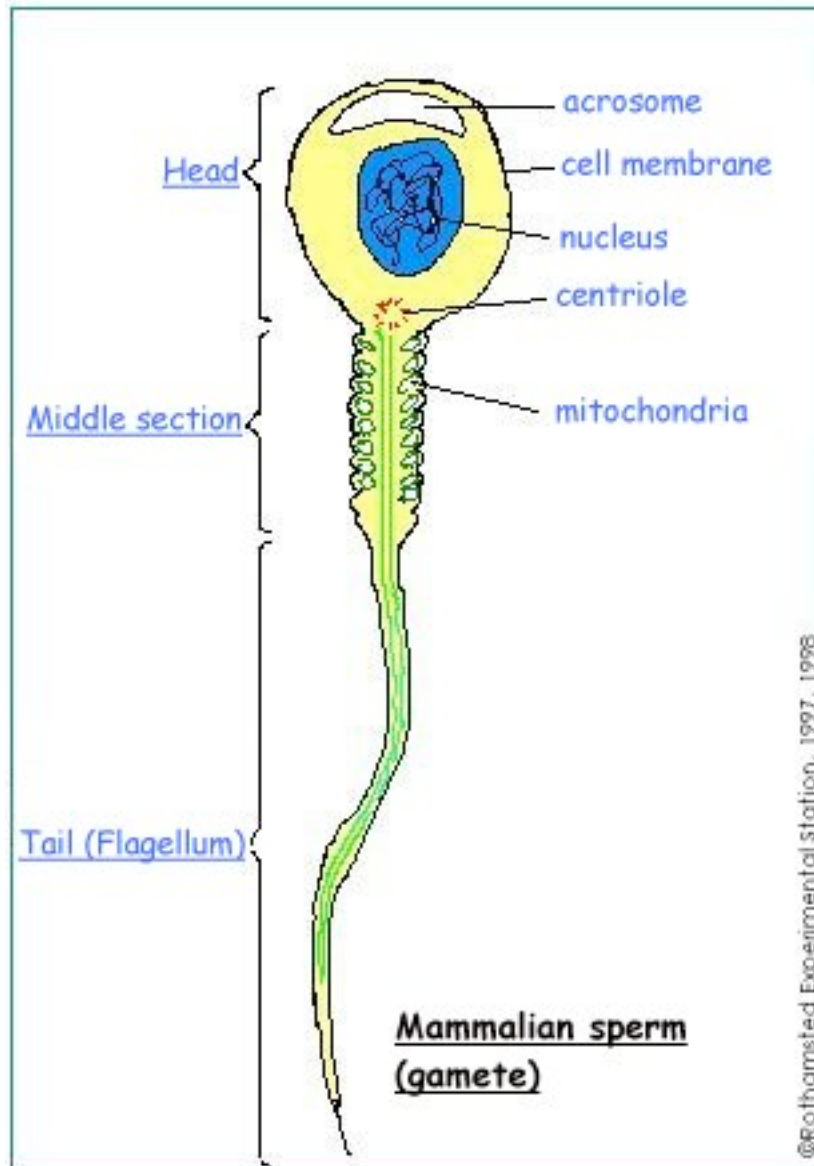
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Zygotes

- Ova
  - Structure
    - Follicle cells outside
    - Zona Pellucida inside them
  - Releases hormones, attracting sperm and triggering lysosome reaction
    - Acrosome swells and fuses with ovum
    - Penetrating Z.P
    - Z.P thickens to prevent other sperm entering

<b>Sperm</b>	<b>Ovum</b>
Acrosome	No acrosome
Tail	No tail
Mitochondria	Mitochondria
No lipids	Lipid stores
ATP store	No ATP store
Haploid nucleus	Haploid nucleus

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- Sperm



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- Lysosome
  - Digestive enzyme triggered by Z.P hormones
  - Causes 'jelly-like' ovum coating to thicken, denying entry to other sperm

Newly fertilised egg = ZYGOTE

Mitosis

Produces 2 ('to') diploid cells

- **Interphase**
  - Organelles & DNA replicate
    - No Interphase in zygote
    - Appearance

- Nondescript, no obvious chromosomes
  - Dark patches = nucleoli containing ribosomes
  - DNA is unravelled for replication
- **Prophase**
  - Chromatids thicken
  - Spindle forms, centrioles acting as anchors
  - Centromeres join chromatids
  - Nuclear Envelope disintegrates
- **Metaphase**
  - Centromeres attach at equator
- **Anaphase**
  - Centromeres split
  - Spindle shortens
  - Spindle breaks down when chromatids reach poles
- **Telophase**
  - Reverse prophase
  - Chromatids lengthen
  - Nuclear envelop reforms
- **Cytoplasmic Division**
  - Protein filaments & microfibrils condense cell at neck, pinching cytoplasm apart
  - In plants, ribosomes build a **new cell plate** between the two cells

#### Mitosis

- Ensures genetic stability
  - Every cell has the same DNA in a body
  - Growth and repair
  - Asexual reproduction
    - Binary fission in bacteria

#### meiosis

- Produces 4 haploid cells
- Promotes genetic variation through random assortment

#### Stem Cells

- Totipotent
  - <8 cells in embryo

- Pluripotent
  - <50 cells in embryo, BLASTOCYST
- Multipotent
  - E.g Bone marrow; can form multiple nerve cells
- Uses
  - Tissue Typing
    - 20 tissue lines would provide for 90% of the pop
  - Immunosuppressants
    - Suppress immune system
  - Therapeutic cloning
    - Diploid nucleus from adult into embryo
    - Therefore forming a blastocyst which matches the patient
    - Ethics

<b>For</b>	<b>Against</b>
To alleviate human suffering	Pandora's box; slippery slope
Ovums from IVF wasted	Other cells viable
Could improve understanding	Embryo = person
Embryonic cells most versatile	Odd side effects?
Save children with congenital diseases	Pressure to superovulate

#### Promoter region

- The location for RNA polymerase to bind on a gene
- If blocked or absent, expression won't take place.

#### FOP

- Caused by misproduction of BMP-4 hormone which stimulates bone growth in monocytes. If a repressor is missing, bone grows everywhere.
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#### Homeobox genes

- Master genes which control differentiation of organs and orchestrate development

#### Melanin stuff

- Tyrosinase synthesizes melanin
- When stimulated by Melanocyte Stimulating Hormone (MSH)
  - MSH receptors increases in UV light
- Melanin produced in melanocytes, then put → melanosomes, which gather around nucleus to protect it

## Cancer

- Inherited
  - Comes from lack of repairing genes for DNA
  - Breast cancer
    - Looking for specific, hereditary mutations
    - Preventative surgery may be possible
- Mutagens
  - Asbestos
  - Tar
  - UV light
- Viral
  - Viral infections can trigger cancer, possibly due to transfer of oncogenes
- Free radicals
  - Cause mutation by oxidising stuff
  - Combated by free radicals
- Humane Genome project
  - 30 → 40 000 genes
  - 50%= Junk DNA
    - Shows evolution
  - Uses
    - Identification of new genes and identifying threats
    - Identifying new drug targets
    - Personalised drugs
    - Understanding basic biology better
    - Showing and understanding evolutionary progress
  - Issues
    - Insurance
    - Who should use them; better not to know?
    - Obligatory?
    - Should it determine eligibility for treatment?

- Egenics

#### Screening

- Can combat diseases such as Duchenne muscular dystrophy
  - Which is sex linked

#### Germ line therapy

- Inserting desired genes into germ cells i.e. zygotes

#### Protein Trafficking

1. DNA → mRNA, mRNA moves out
2. mRNA attaches to ribosome
3. Proteins made on ribosomes, enter RER
4. Protein assumes end shape and is packaged as it moves through ribosomes
5. Vesicle is pinched off
6. Enters Golgi apparatus
7. Proteins modified to fulfill final function
8. Final vesicles are pinched off, containing final protein
9. Exit cell by exocytosis

#### Acetabularia

- 2 strains, different hats
- Nucleus and stem separated, hybridized
- Stem in the short term determines hat
- If hat chopped off, new, regrown hat matches nucleus

#### Cloning

- Dangerous; **oversized babies**
- Develop diseases such as arthritis quickly

#### Gene Expression

- Attaching a methyl (-CH<sub>3</sub>) group to a gene deactivates it
- Gene expression requires **RNA polymerase & suitable transcription factors** to attach to the **promoter region on the DNA.**
  - Transcription factors
    - Some always present

- Some specially synthesized
- Some only activated by hormones (growth factors etc)
- Expression can be prevented by protein repressor molecule
  - Which prevents transcription factor binding by blocking the promotor region
    - . E.G. in **B-Galactosidase in E.Coli**, lactose inhibits the repressor molecule, allowing the transcription of lactose digesting enzyme (B-Galactosidase)
- Signalling
  - Direct
    - Signal protein passes into nucleus, acts as transcription factor
  - Indirect
    - Signal protein binds to receptor, causing messenger molecule to be released in cell, which acts as transcription factor

#### Nature Vs. Nurture

- Height
  - Nat + Nur
    - Taller men more attractive/ reproductive
    - More protein in diets, less inbreeding, better medicine, less child labour, better heating & housing
      - All lead to increasing height
- Cancer
  - When cell multiplication > apoptosis
  - DNA damaged through mutagens (UV light, asbestos, tar) or incorrect gamete formation
    - **Oncogenes**
      - Code for stimulating proteins in the cell cycle, perpetuating it
      - Too many = Cancer
    - **Tumour Suppressant Genes TSG)**
      - Produce cycle stopping proteins.
      - If inhibited, → cancer



- At checkpoints in the cell-cycle (perpetuated by cin & cyclin dependent kinases)
- Chemicals are released to continue the cycle
- The build up of CDK catalyses **phosphorylation of other proteins, making them active**
- **Cancer**

<b>Natural</b>	<b>Inherited</b>
Chemical: tar in bronchi causes mutation in epithelial cells	About 5% is inherited
Physical: UV light, moles → Tumours	Lack of DNA repairing proteins, or odd ratios of onco/TSG
Diet: Free radicals	Mutations accumulate in the sperm of older men

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- **Metastasis**
  - The spread of cancer
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