Source: [KBhBIO101Cells]

1 | The Cell Cycle

1.1 | So, why do cell divide

> The ability to produce organisms more of their kind is one characteristic that best distinguishes living things from nonliving matter

Viruses + Organelles challenge this definition => they are symbiotic and cannot reproduce on their own. We tend to think that cells

- Everyday, 50-70 Billion die => **programmed cell death**
- To compensate this, Mitosis (cell division) happen
    - Cell divide in opposite directions
    - Two strands ANTIPARALLEL to each other

Before we continue, do yourself a favor and review [KBhBIO101DNAStructures]

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lecellcycle.png

1.2 | So, how do cells divide?

[KBhBIO101CellReproduction]

1.3 | The (actual) Cell Cycle

The cell cycle is roughly three parts which is really 5 parts which is really 9 parts.

The three main parts are

- **Interphase** — G1, S, G2: systems preperation for mitosis
- **Mitosis** — Separation of the duplicated chromosomes
- **Cytokinesis** — the splitting of the cell itself. Really part of mitosis

1.3.1 | G1 => Rest Phase, Gap 1

This is the phase which is the “daily life of a cell”. There are two major checkpoints in this phase which, upon it is reached, sets the rest of the cell cycle into motion.

- May hit s.a. to volume checkpoint => if ratio too big, the cell is too big
- May hit diffusion checkpoint => larger cells would need to work harder to transport things to the centre

At this phase, the organelles in the cytoplasm also replicates in preparation for the S phase.

1.3.2 | S => S Phase, duplicate DNA. 150 mins

In this process, all of the DNA that is in the nucleus will be [KBhBIO101DNAReplication]ed in order to actually split the cell in half.

1.3.3 | G2 => Rest Phrase, Gap 2.

The pairs of DNA begins bundling and condensing; the DNA is also checked upon and verified for consistency and dumped based the needs of the cell.

At this point, the enzymes needed to assist Mitosis is also synthesized.

1.3.4 | M => Mitosis!

Mitosis is the process by which the cell actually divide. It consists of four parts — prophase, metaphase, anaphase, telophase — and a final seperation called cytokenisis

Prophase

The cytoskeleton of a cell disassembles, and the spindles to seperate the cell begins to form.

The centrioles, the proteins connecting all the spindles, separate to opposite poles of the cell and establishes the bridge of all the microtubuels called the "spindle apparatus".

Protein "joints" in the centromeres of chromasomes called kineticore attach to a spindle after the nuclar envelope erupts.

Metaphase

The microtubuals guide the proteins to align in the equator of the cell called the "metaphase plate".

Organelles are also moved by being pulled by the motor proteins and their spindles.

Anaphase The centromere's centre degrades, freeing the two halfs of the chromasomes.

Kinetore senses tension, and when it is correct, molecules are sent down the microtubials to send a split signal. Yanked by their kineticores by the microtubuals, each copy of the chromatid moves towards one pole of the cell.

Telophase A "cleavage furrow" forms in the centre of the cell created by actin on the circumference constricting. As this cleavage deepens (the actin constricting further), the chromasomes unravel whilst a new nuclear envelope forms.

The spindle apparutus now disassembles; the microtubuals are broken down further into monomers that will eventually construct the exoskeleton of the new cells.

Cytokinesis In animals… the cleavage furrow deepends even more and **extends** to the point where the two cells fully seperate. In plants… because there's no actin fibers to constrict the cell wall (it's too hard), vescles between the new cells form that pads out the twe newly-formed cells called the "cell plate." During cytokinesis, the cell plate widens to the point where two cells seperate.

1.4 | Features of the Cell Cycle

Most cell division results in genetically identical daughter cell

Each cell, once specialised, chooses what parts of their chromasome to unwrap + permanently wrap.

Difference in transcription results in different phenotypes.

Sperm + Egg (imcomplete cells) combine together to form a "zygote" => a single cell. Each person is from a zygote.

Paul's Cell Cycle Primer

Screen Shot 2020-11-09 at 3.16.12 PM.png

1.5 | Cell cycle regulation

Purpose of regulation: **Cells must meet certain conditions before moving onto the next phase.**

Cell regulators are proteins that manage and sheperard the process of cell division. They respond to molecular signals throughout the cell and check for internal signals like DNA damage to control the rate and progress of cell division.

The Problem: **Cells need to know whence to divide itself.**

Drivers tell cells when to divide. The processes that move a cell forward through its life are called “drivers”.

- Drivers consists of two parts: a switch + a cyclin
  - a “switch” turns on a “cyclin” protein
  - this cyclin protein actually drive cell forward
- Checkpoints regulate drivers’ actions
  - Should the cells not meet the requirements of a checkpoint, its driver would be stopped; and/or
  - It will be called to self-destruct

1.5.1 | Common cell-cycle checkpoints

- **G1/S Checkpoint** (After S) — external factors and growth factors (nutrients, raw material, DNA damage) , along with measurements of the volume, shape of the cell and the duplicated DNA, ensure that the pre-G2 cell is intact and healthy before moving onto G2
- **Inter s-checkpoint** (During S) — during S, check for DNA damage.
- **G2/M Checkpoint** (After G2) — before mitosis, check that the cell has correctly duplicated parts and tools needed for replication
- **Spindle Checkpoint** — checking for the attachment of all kineticores to the spindles such that all the chromasomes could be correctly lined up and seperated later

Growth Factors that the cells measure: the 1) Size of the cell 2) the nutritional state of the cell

Positive Regulators push the cell cycle forward, CDK, upon lots of cycling binding to it and the meeting of checkpoint.

Negative Regulators hold the cell cycle back due to a response to a checkpoint or an environmental factor

1.6 | How about Meiosis?

KBhBIO101Meiosis