1. **Cell Cycle:**
   https://www.youtube.com/watch?v=e6N9_RhD10Q

2. **Mitosis:**
   https://www.youtube.com/watch?v=5bq1To_RKEo&t=29s

3. **Meiosis:**
   https://www.youtube.com/watch?v=kQu6Yfrr6j0

A Simple Comparison of Mitosis and Meiosis

1. Introduction: Why Cells Divide

All living things grow, repair themselves, and reproduce because their **cells divide**. In eukaryotic organisms (organisms with complex cells), there are **two main types of cell division**:

- **Mitosis** – happens in body (somatic) cells for growth and repair.
- **Meiosis** – happens in reproductive cells (sperm and egg) to make gametes for sexual reproduction.

Before we learn about mitosis and meiosis, it's important to understand how a cell prepares for division — this is called the **cell cycle**.

2. The Cell Cycle: How a Cell Prepares to Divide

The **cell cycle** is the series of stages a cell goes through to grow and divide. It has **two main parts**:

1. **Interphase** – when the cell grows and prepares for division.
2. **Mitotic Phase (M Phase)** – when the cell actually divides (includes mitosis and cytokinesis).

Let's look more closely at **Interphase**, because it's where most of the cell's life happens.

Stages of Interphase

1. **G_1 Phase (First Growth Phase)**
   - The cell grows bigger, makes new organelles, and carries out normal functions.
   - This is like the cell's preparation stage before copying its DNA.
2. **S Phase (Synthesis Phase)**
   - The cell copies its **DNA**, so each chromosome now has **two identical sister chromatids**.
   - This ensures that when the cell divides, each new cell gets a full set of DNA.

3. **G_2 Phase (Second Growth Phase)**
    - The cell continues to grow and checks its DNA for mistakes.
    - It also prepares the structures needed for division, like spindle fibers.

After interphase is complete, the cell is ready to start the **M phase (Mitosis)**.

The M Phase

The M phase includes **mitosis** (division of the nucleus) and **cytokinesis** (division of the cytoplasm).

At the end of the cell cycle, two new cells are formed. Each can then start the cycle again.

3. Mitosis: Cell Division for Growth and Repair

Mitosis helps your body grow, heal wounds, and replace dead cells. It creates **two new cells that are identical** to the original one.

The Stages of Mitosis

1. **Prophase**
    - DNA coils into visible **chromosomes** (each with two sister chromatids).
    - The **nuclear membrane** breaks down.
    - **Spindle fibers** form and move to opposite sides of the cell.
2. **Metaphase**
    - Chromosomes line up in the middle of the cell.
    - Spindle fibers attach to the centromeres of each chromosome.
3. **Anaphase**
    - Sister chromatids are pulled apart to opposite ends of the cell.
    - Each chromatid is now considered an individual chromosome.
4. **Telophase**
    - New nuclear membranes form around each group of chromosomes.
    - The chromosomes begin to uncoil, and the **nucleolus** reappears.

Cytokinesis

- **In animal cells:** The cell membrane pinches in and splits into two.
- **In plant cells:** A **cell plate** forms in the middle, which becomes the new cell wall.

Result of Mitosis: Two identical daughter cells, each with the same number of chromosomes as the parent cell.

4. Meiosis: Cell Division for Reproduction

Meiosis happens in reproductive organs to make **gametes** (sperm or eggs). It creates **four different cells**, each with **half the number of chromosomes**. This is important so that when sperm and egg join during fertilization, the zygote has the correct number of chromosomes.

Meiosis I: Separation of Homologous Chromosomes

1. **Prophase I**
    - Chromosomes pair with their matching partners (homologous chromosomes).
    - This forms **tetrads** (4 chromatids).
    - **Crossing over** happens — parts of chromosomes swap places, creating **genetic variation**.
2. **Metaphase I**
    - The homologous pairs line up in the middle.
    - Spindle fibers attach to each chromosome.
3. **Anaphase I**
    - The homologous pairs are pulled apart to opposite sides.
    - Sister chromatids stay together.
      → The cell now has half the number of chromosomes.
4. **Telophase I and Cytokinesis**
    - The cell divides into two **haploid** cells (each with half the chromosome number).

Meiosis II: Separation of Sister Chromatids

No DNA replication happens before this stage.
The steps are almost the same as mitosis.

1. **Prophase II** – In each of the two cells, the nuclear membrane disappears, and spindle fibers begin to form.
2. **Metaphase II** – The chromosomes in each cell line up individually along the equator, with spindle fibers from opposite poles attaching to each.
3. **Anaphase II** – In a process mechanically identical to mitotic anaphase, the spindle fibers separate the sister chromatids. The now-individual chromatids (reclassified as chromosomes) move to opposite poles.
4. **Telophase II and Cytokinesis** – Nuclear membranes reform around the four sets of chromosomes, and the cytoplasm of both cells divides.

Result of Meiosis: Four haploid gametes that are **genetically different** from each other and from the parent cell.

5. Key Differences Between Mitosis and Meiosis

Feature	Mitosis	Meiosis
Purpose	Growth and repair	Production of gametes
Number of divisions	One	Two
Crossing over	No	Yes (in Prophase I)
Chromosome number in new cells	Same as parent (diploid)	Half the parent (haploid)
Number of daughter cells	Two identical cells	Four different cells
Genetic result	No variation	Creates variation

6. Why These Processes Are Important

- **Mitosis** keeps the organism stable and functioning by making exact copies of cells.
- **Meiosis** ensures genetic diversity, which helps species adapt and evolve over time.

7. Conclusion

The **cell cycle** shows how cells grow, copy their DNA, and divide.

- Through **mitosis**, organisms grow and repair themselves using identical cells.
- Through **meiosis**, they create unique sex cells for reproduction and variation.

Together, these processes maintain both the **stability of life** and its **diversity**, ensuring the continuation of all living organisms.