THE CELL CYCLE

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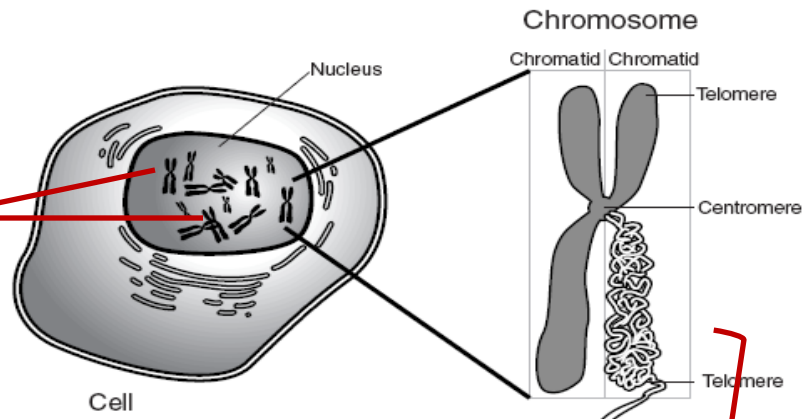
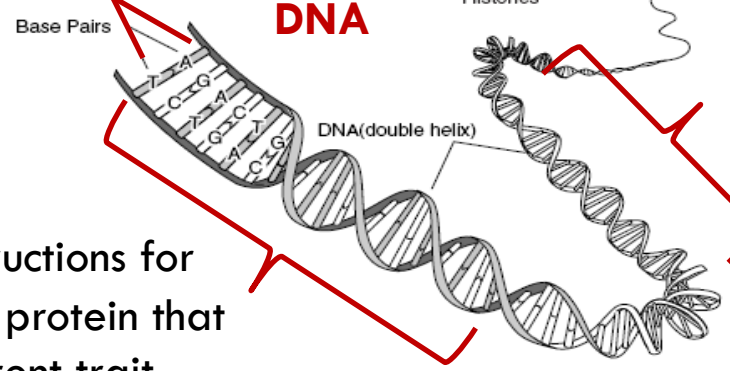
Chromosome Review

Chromosomes: DNA tightly coiled around little protein balls (histones) to make it *very* compact



Chromosomes unraveling into **DNA**

Nucleotide Base Pairs



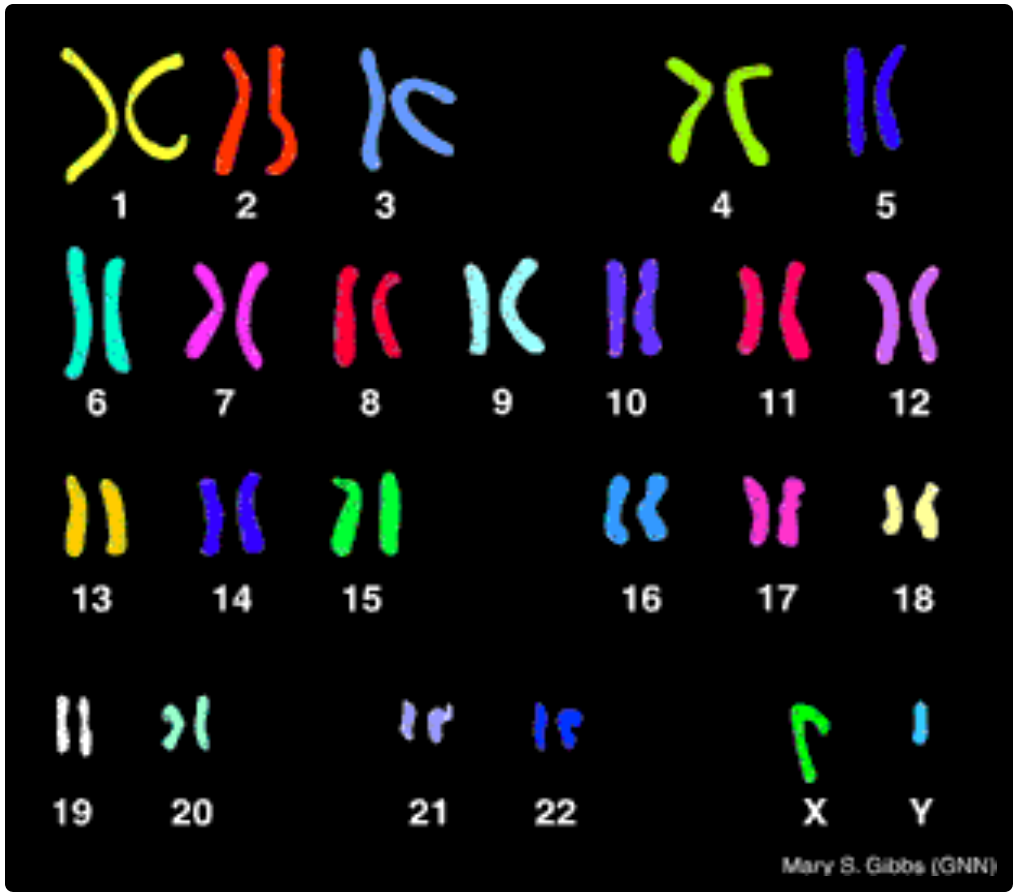
DNA

Gene: Instructions for making a protein that determines a trait

Another **Gene:** instructions for making a different protein that determines a different trait

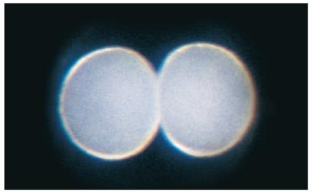
More about Chromosomes

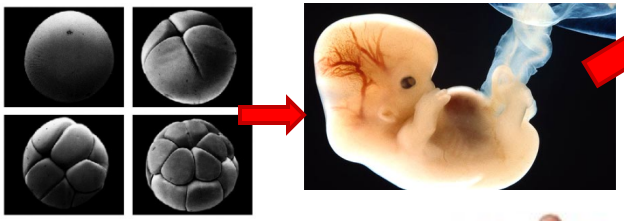
- Contain DNA
- Number varies with organism:
  - Humans: 46
  - Cats: 32
  - Dogs: 72

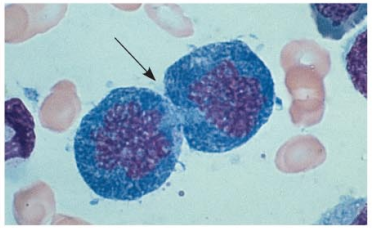


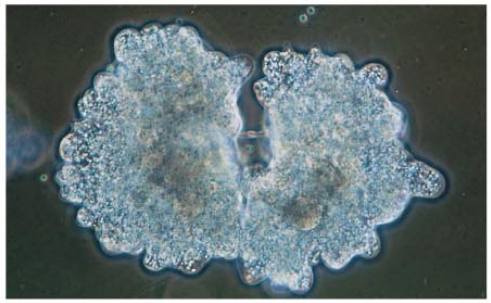
The Cell Cycle:

- One cell grows and divides into two new cells
- Purpose:
  - Growth
  - Replace dead cells
  - Repair tissues after injury
  - Asexual reproduction (in single-celled organisms)





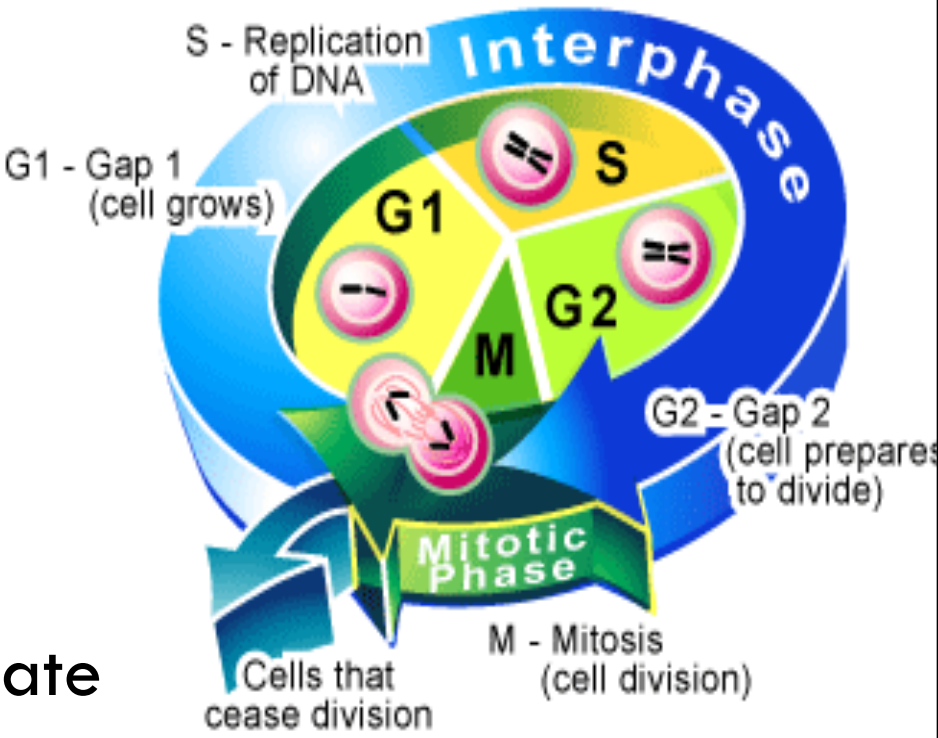




Amoeba reproducing

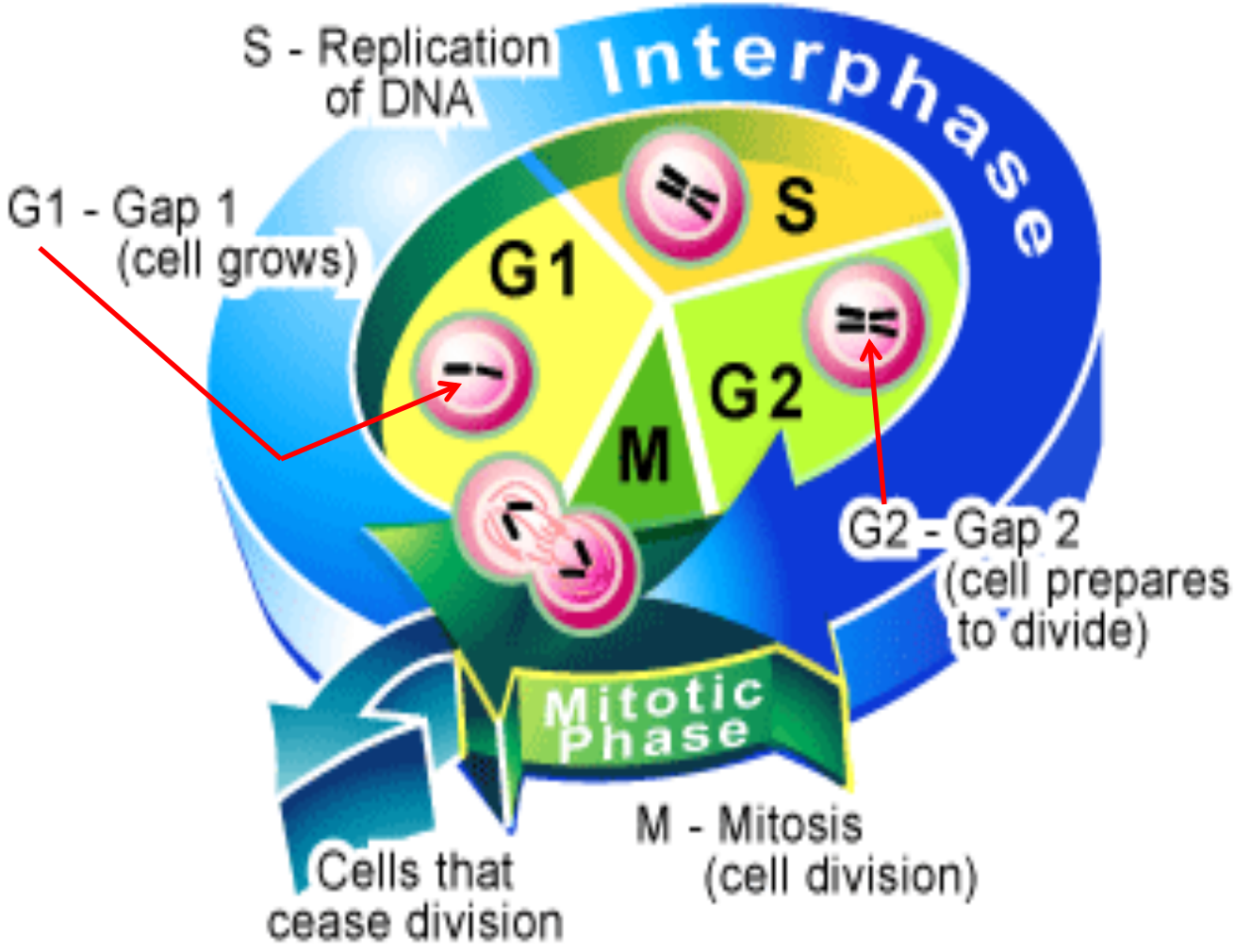
Major Steps of the Cell Cycle

- **Interphase:** growth; copying of chromosomes & organelles
  - **G1 phase:** Cell grows
  - **S phase:** DNA replicates
  - **G2 phase:** More growth; cell prepares to divide



- **Mitosis:** Chromosomes separate to form two new nuclei
- **Cytokinesis:** Cell splits to form two new identical cells

What do you notice about the **chromosomes** in G1 versus G2?



Chromosome Replication During the Cell Cycle

G1 Phase:

- Chromosomes are **un-replicated** - each contains <u>one</u> <u>copy</u> of its DNA

Un-Replicated Chromosome

Centromere – a small spot in the center of a chromosome

S Phase:

DNA Replication creates replicated chromosomes

G2 Phase:

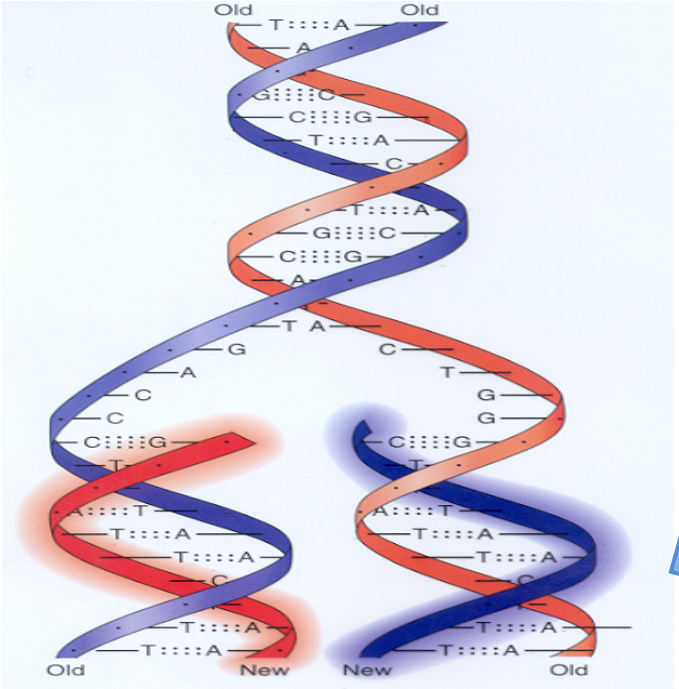
- Chromosomes are **replicated** - each contains <u>two</u> <u>exact</u> <u>copies</u> of its DNA

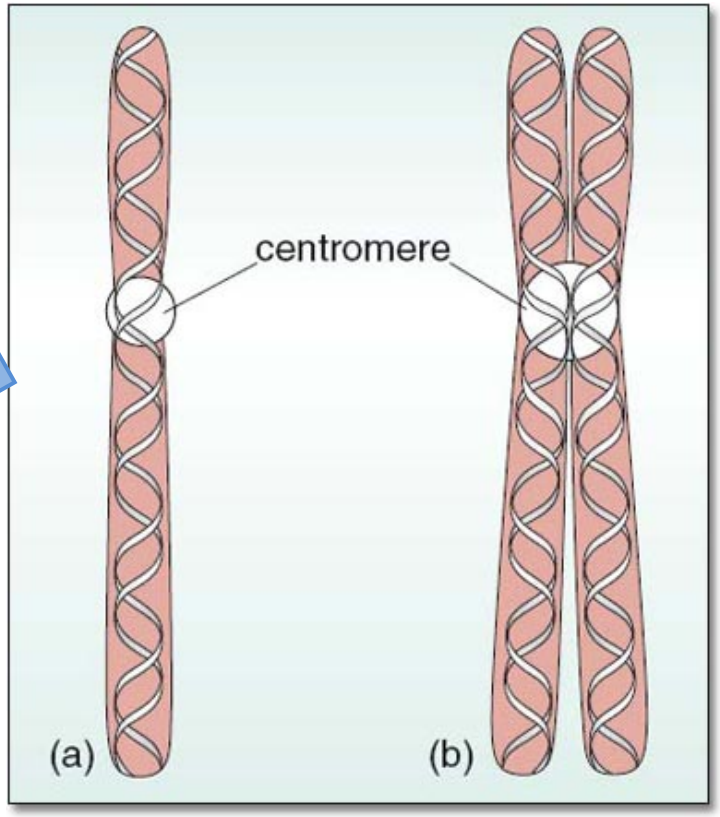
Centromere

Replicated Chromosome

Sister Chromatids
– two halves of a replicated chromosome
– **exact copies** of each other

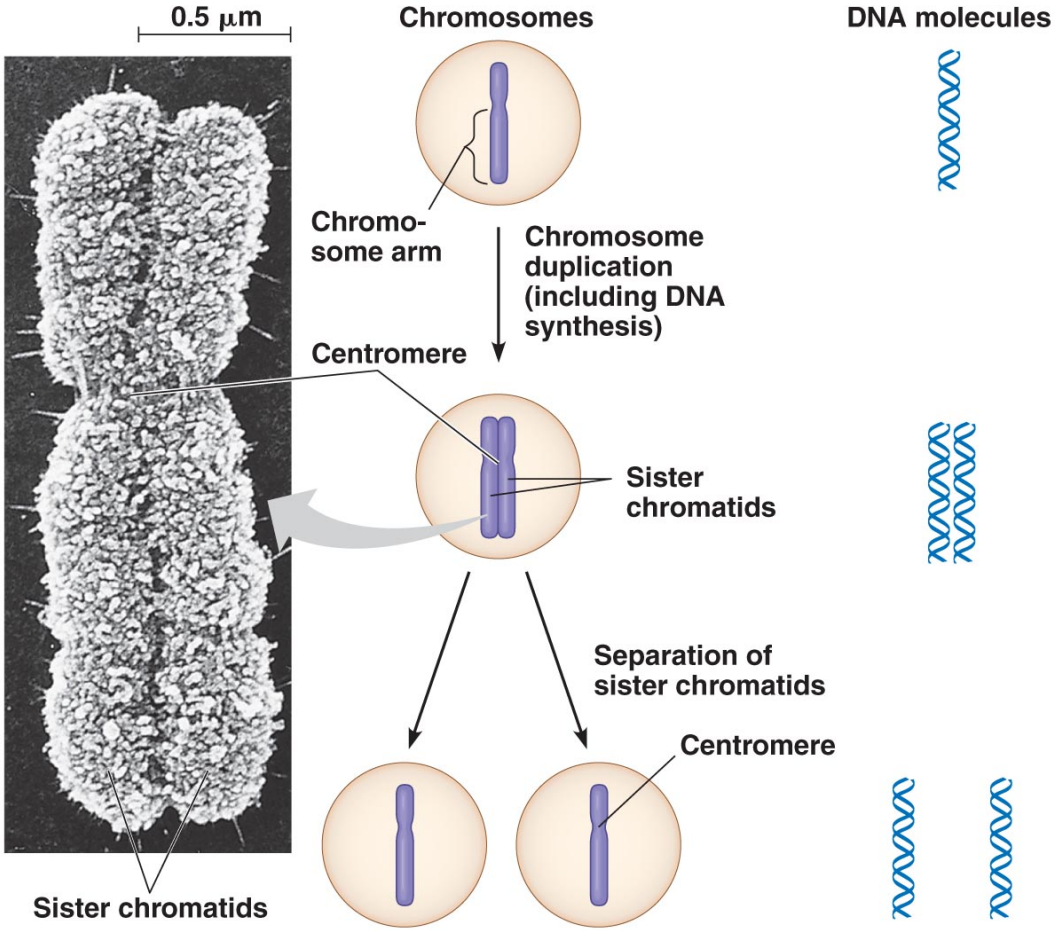
More images of Chromosome Replication





- Mitosis is responsible for new cells in the developing embryo, fetus, and child. It is also responsible for replacement cells in an adult.
- Mitosis is duplication division. The nuclei of the two new cells have the same number and types of chromosomes as the cell that divides.
- The cell that divides is called the parent cell, and the new cells are called the daughter cells. The parent cell and daughter cells have the same number and types of chromosomes, so they are genetically identical.

Why do Chromosomes Replicate?



- So they can **split** during **mitosis** and separate into **two new cells**
- Each cell gets an exact copy of each chromosome!

Objectives for Class:

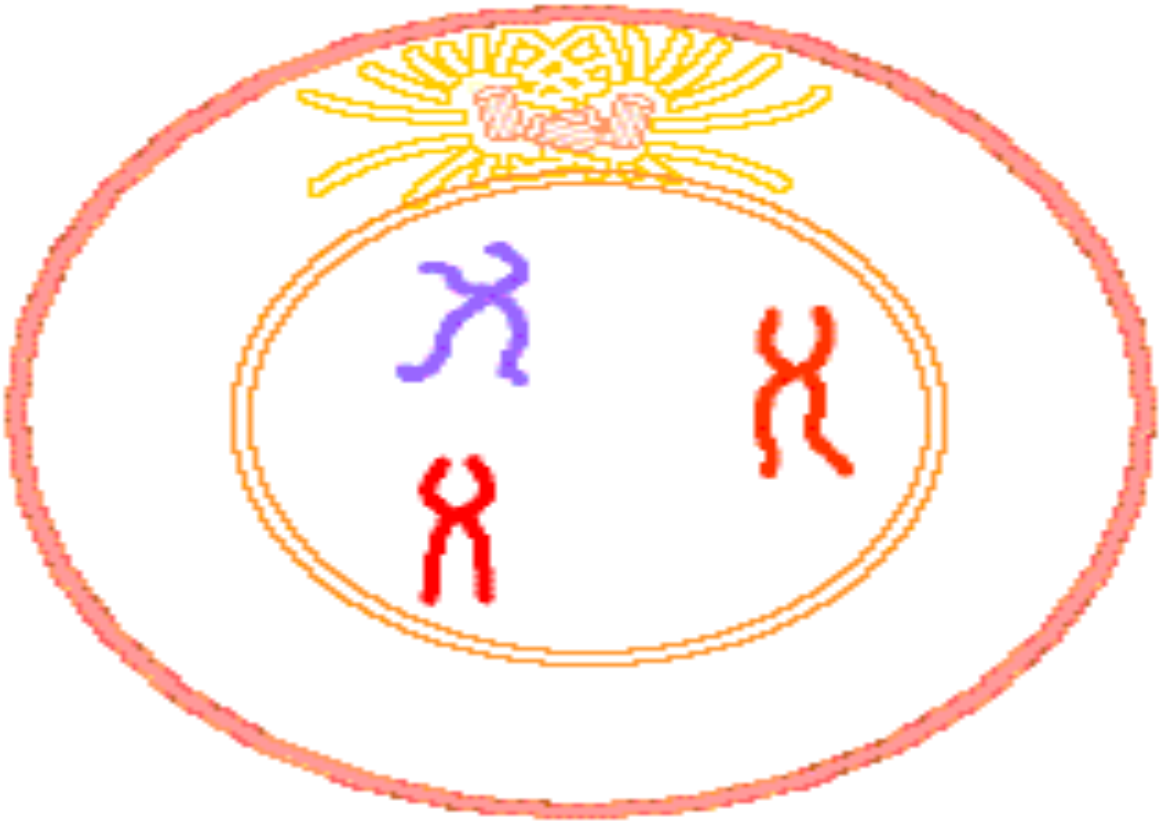
Describe the purpose and steps of mitosis and cytokinesis.

Draw diagrams showing how mitosis/cytokinesis separate chromosomes into two new cells.

M-Phase: Mitotic Division

- **Mitosis:**
  - Chromosomes separate to form two new nuclei
- **Cytokinesis:**
  - Cell splits to form two new identical cells

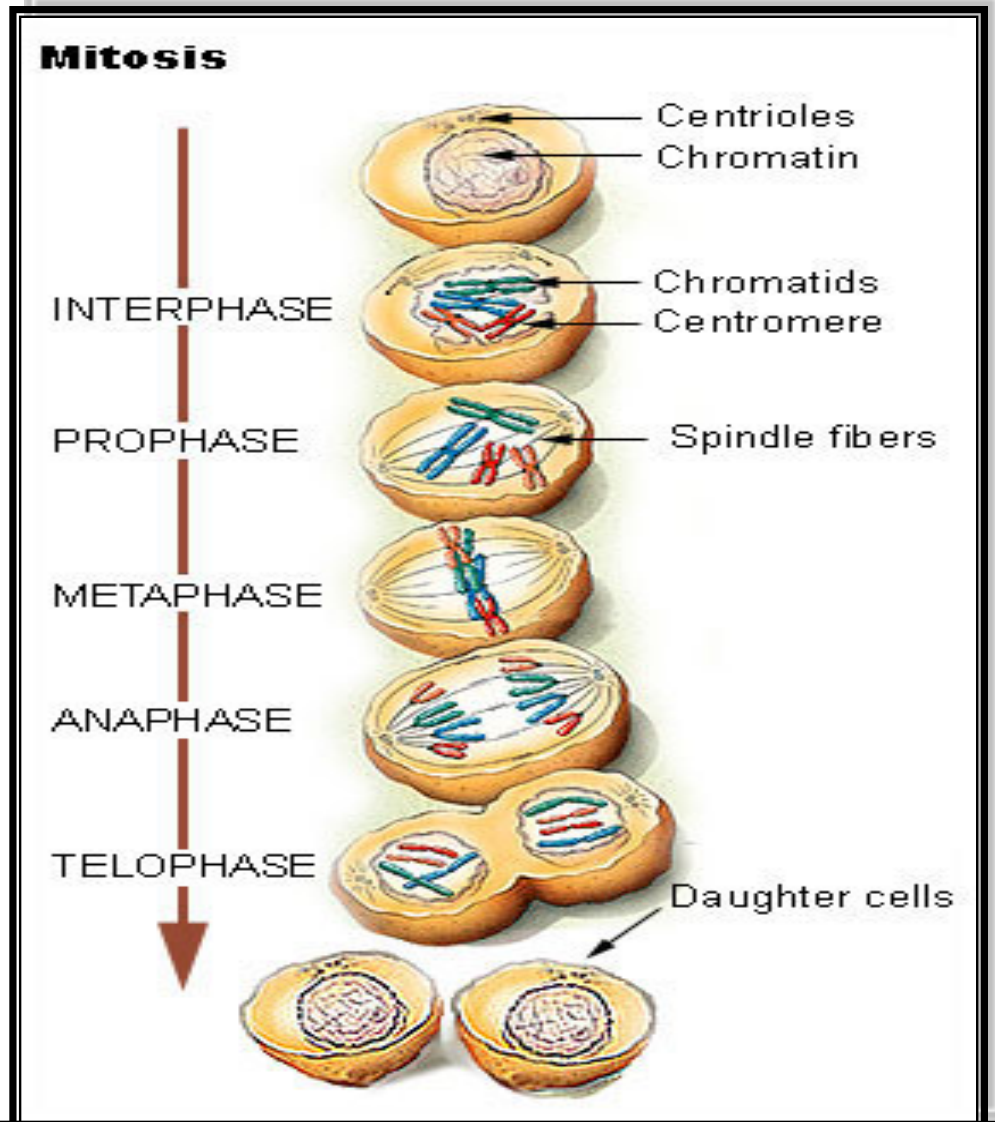
Mitosis Animation



Prophase:

- condensation of chromosomes
- disappearance of nucleoli and nuclear envelope

What happens during Mitosis?

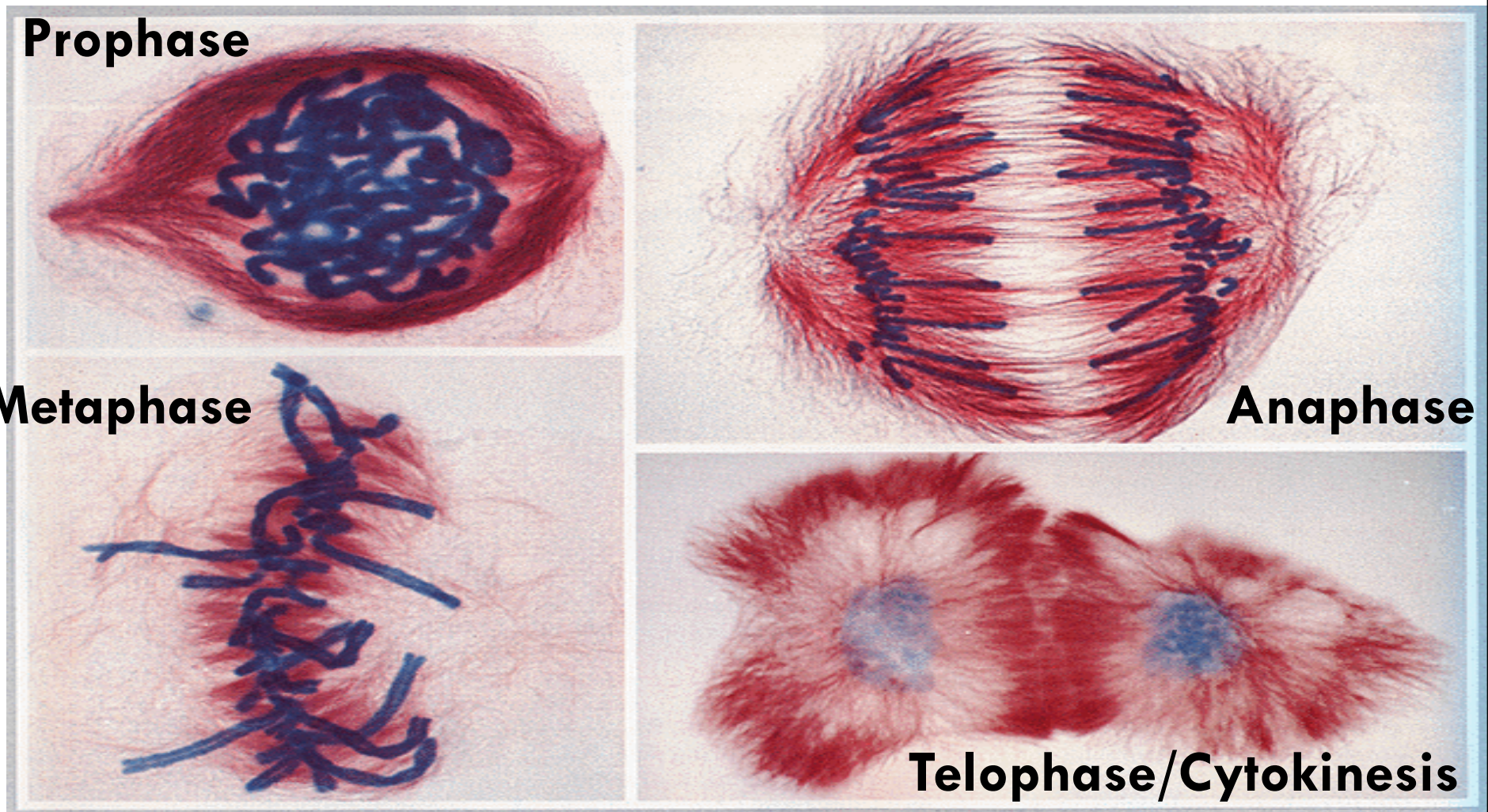


Interphase
(can't see difference between G1, S, G2)

Animal cell:

Plant Cells:

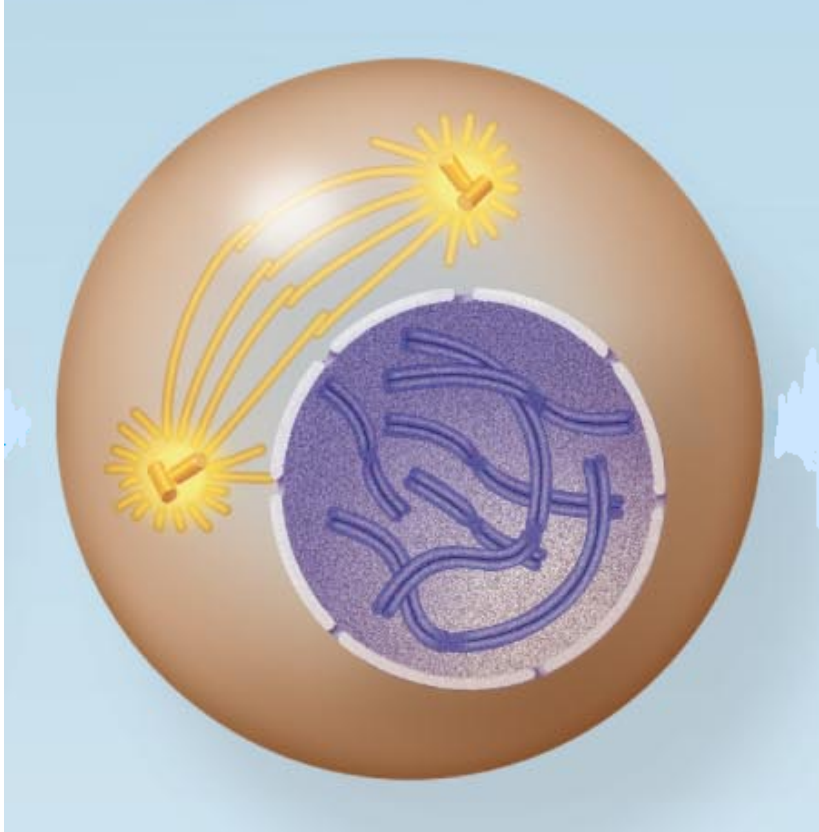
Stages of Mitosis



Plit cells in various stages of mitosis: (a) prophase; (b) metaphase; (c) anaphase; (d) telophase (all magnified about 2,700 times).

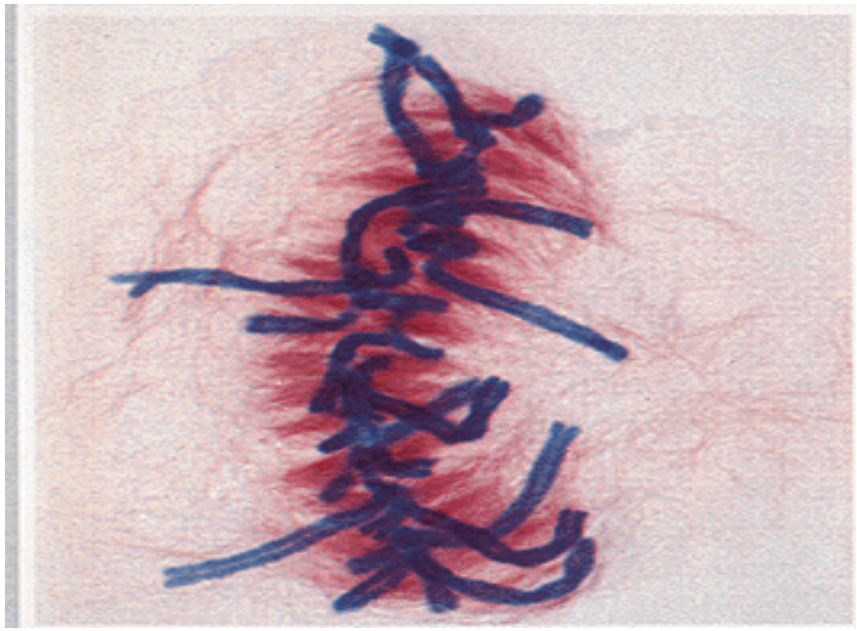
Mitosis Stages: Prophase

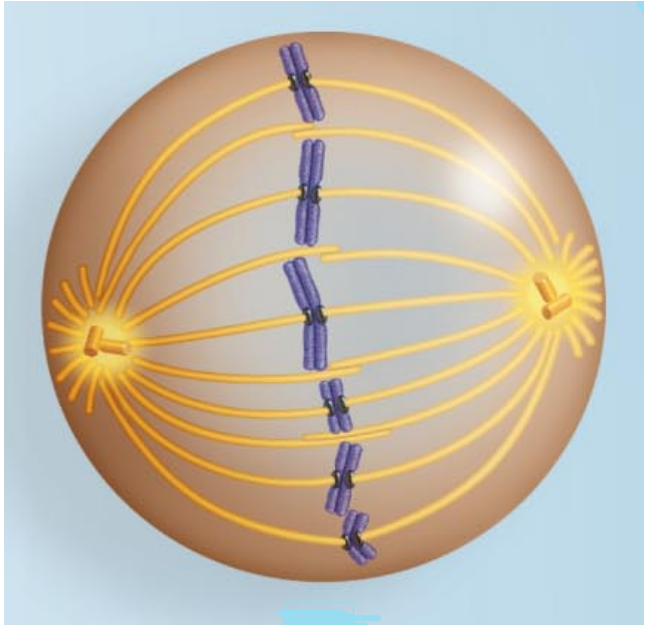
- Chromosomes become visible with disappearance of nucleolus.
- Nuclear envelope disappears.
- Duplication of centrosome
- Spindle fibers form between the ends (poles) of cell.



Mitosis Stages: Metaphase

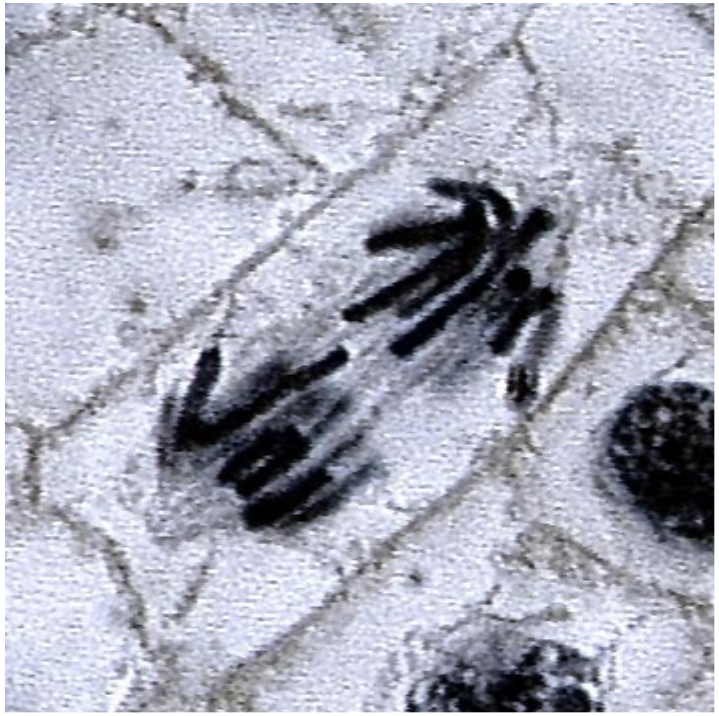
- Chromosomes line up at the center of the cell or equator
- Spindle fibers attach to Chromatids, as they prepare to pull them apart
- Metaphase is characterized by a fully formed spindle.





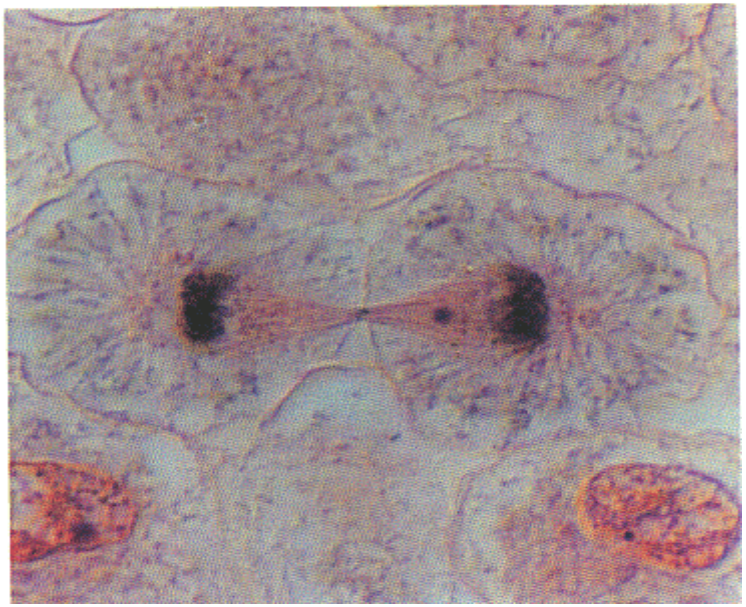
Mitosis Stages: Anaphase

- Chromatids (or pairs of chromosomes) separate and begin to move to opposite ends of the cell



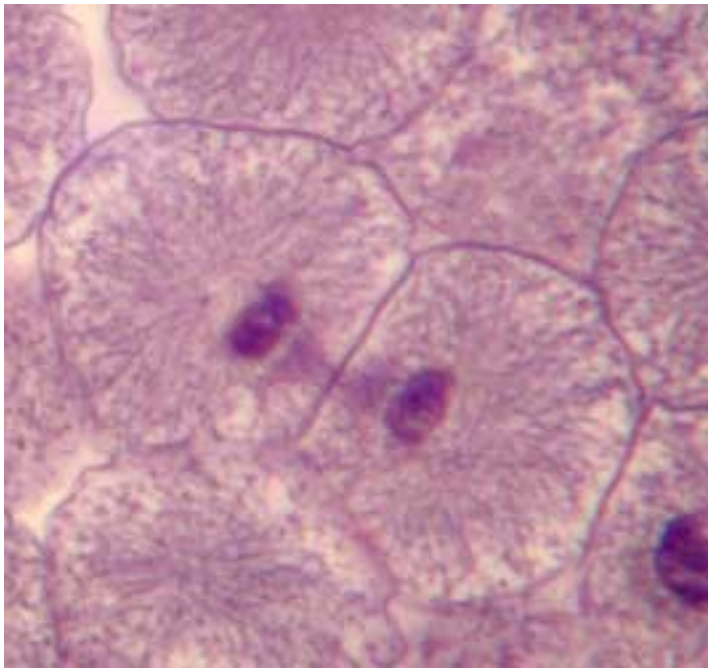
Mitosis Stages: Telophase

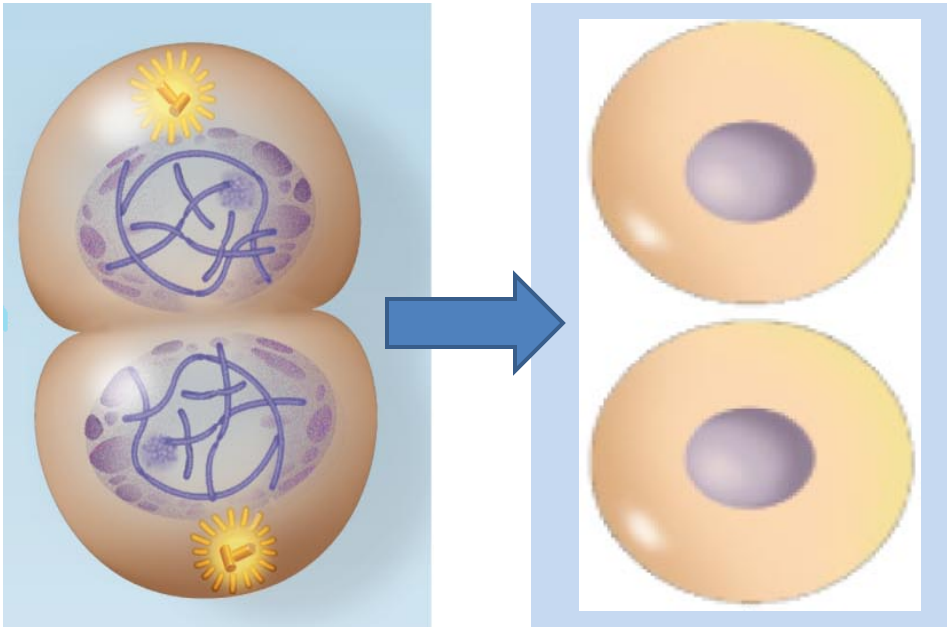
- Two new nuclei form
- Chromosomes become less visible
- Mitosis is finished!



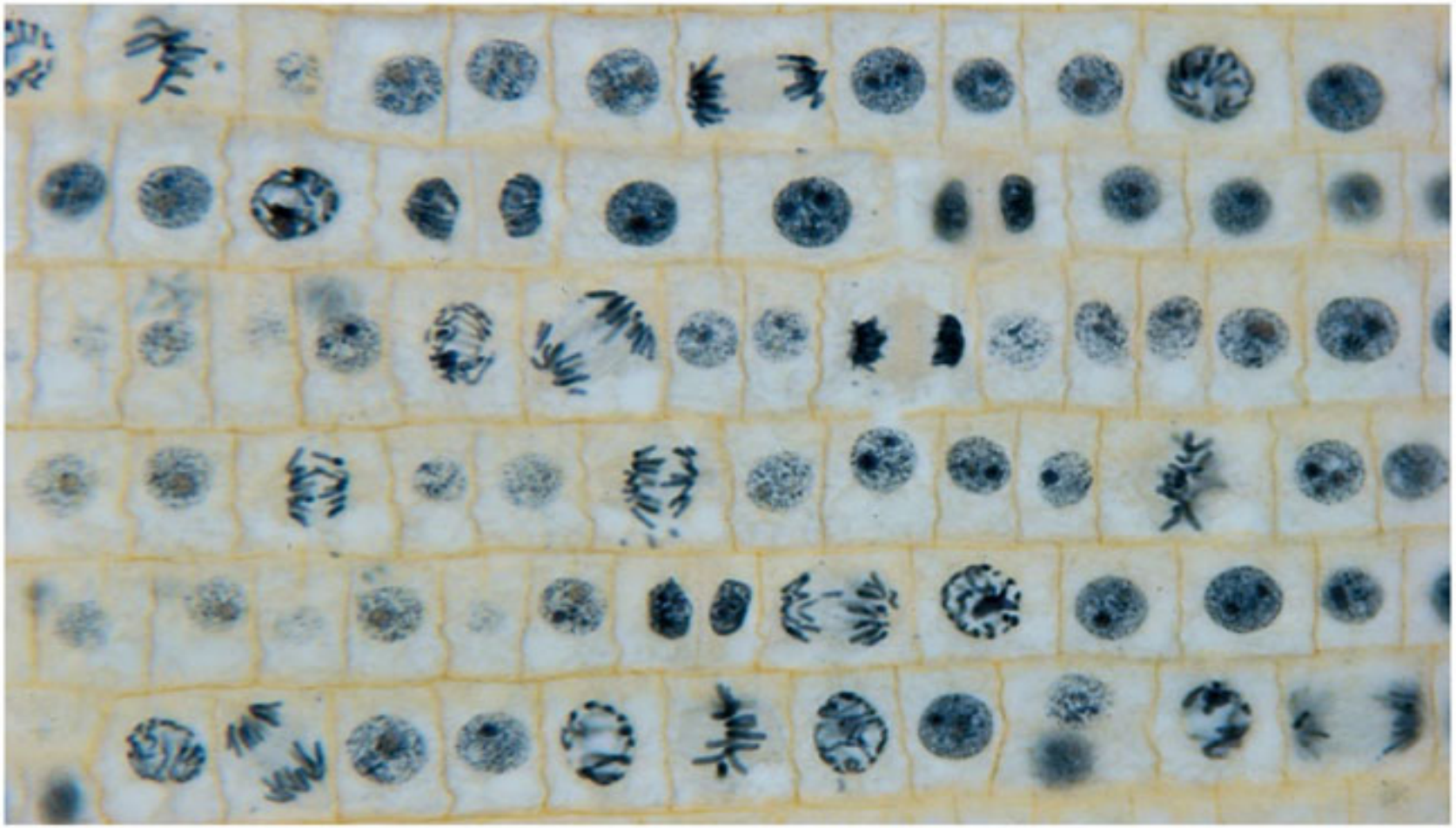
Cytokinesis

- Cell membrane moves inward to create two daughter cells – each with its <u>own</u> <u>nucleus</u> with <u>identical chromosomes</u>





Mitosis: Plant cells in mitosis



How many cells are in each phase?

What percent of cells are in each phase?

Which phase is the longest? Shortest? How can you tell?