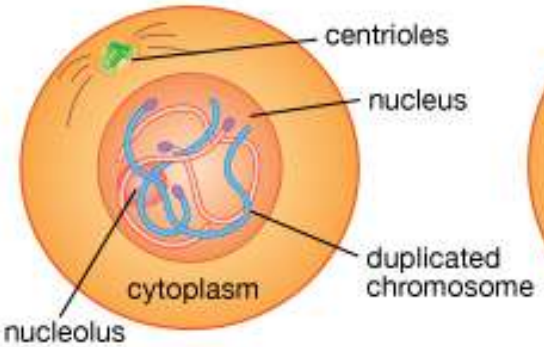
MITOSIS

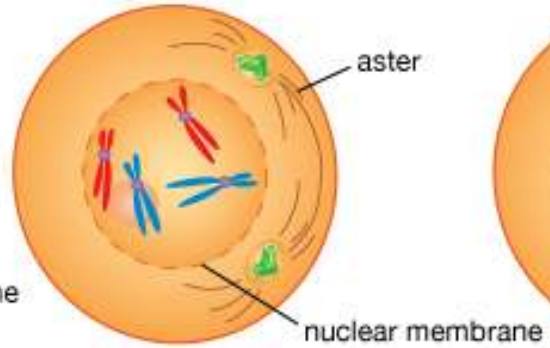
If you need help understanding the info in this presentation, please refer to your book for clarification. 12.2

Unit 4

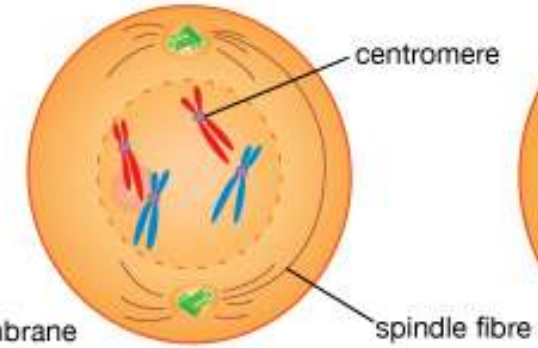
Mitosis, or somatic cell division



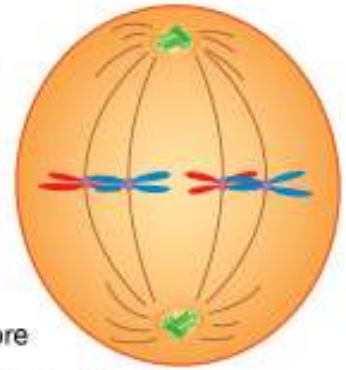
Prior to mitosis, each chromosome makes an exact duplicate of itself. The chromosomes then thicken and coil.



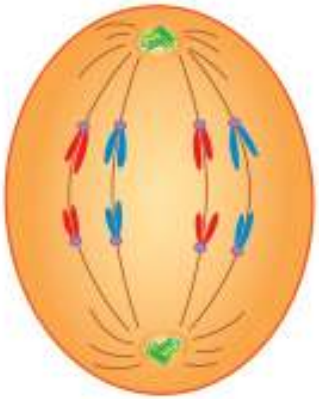
In early prophase, the centrioles, which have divided, form asters and move apart. The nuclear membrane begins to disintegrate.



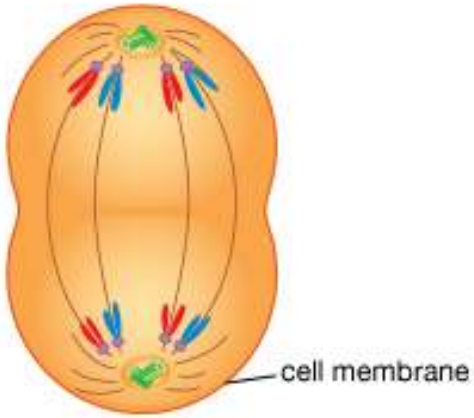
In late prophase, the centrioles and asters are at opposite poles. The nucleolus and nuclear membrane have almost disappeared.



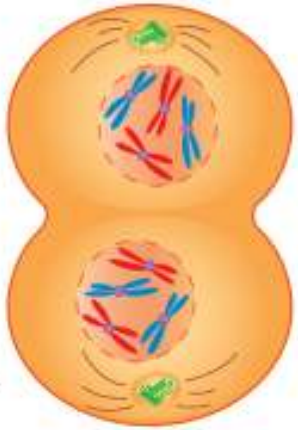
The doubled chromosomes—their centromeres attached to the spindle fibres—line up at mid-cell in the metaphase.



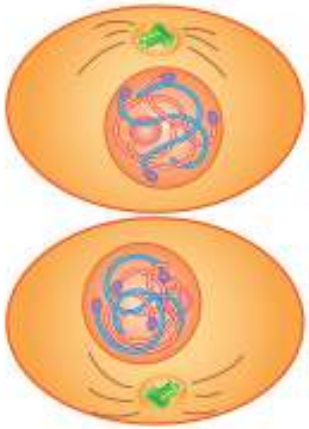
In early anaphase, the centromeres split. Half the chromosomes move to one pole, half to the other pole.



In late anaphase, the chromosomes have almost reached their respective poles. The cell membrane begins to pinch at the centre.



The cell membrane completes constriction in telophase. Nuclear membranes form around the separated chromosomes.



Mitosis completed, there are two cells with the same structures and number of chromosomes as the parent cell.

Ok, time for Mitosis

- Don't worry about the names of the phases
  - (The book shows all the names but you don't need to know them)

- Here are the highlights:

- A cell divides…
- now there are two.

Mitosis

- Ok, for real now

- What is mitosis and why is it needed?
  - What? A multicellular organism needs to produce new cells for growth and replace old or damaged cells.
  - Why? It's a process that produces cells that are <u>EXACTLY</u> the same as the parent cell.
    - Keeping the genes the same is essential!

Mitosis is a form of asexual reproduction

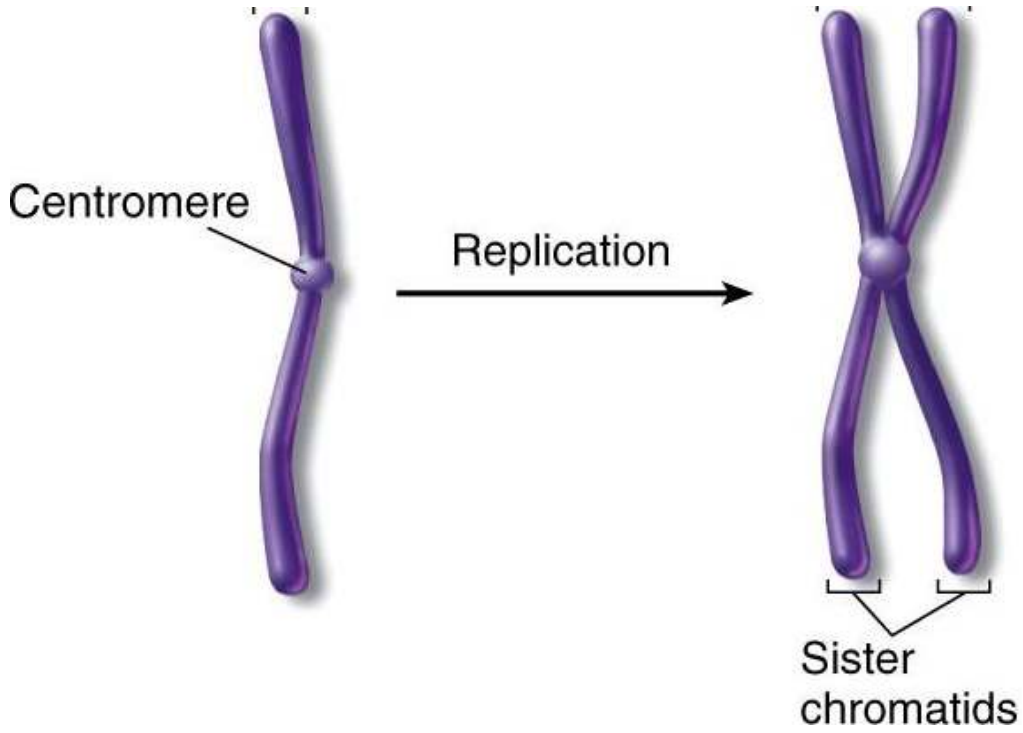
- Comparing asexual and sexual reproduction
- Asexual
  - One parent produces one offspring
    - No exchange of genetic information
    - No new genetic combinations
    - Just a new cell that is essentially a clone of the original cell
- Sexual
  - 2 parents produce one offspring
    - New unique genetic individual

Mitosis in less than 60 seconds

- Here's all it is:
  - The cell has an organized process that separates the DNA so each of the two daughter cells ends up with a copy of each chromosome- produces cells that are exactly the same
    - Replication (Interphase)
    - Alignment of chromosomes
    - Separation of chromosomes
- Why is this such a big deal?
- Mitosis produces more somatic cells. Meiosis produces gametes

Don't forget DNA replication!

- Chromosomes are coiled up DNA strands (chromatin)
  - Makes it way easier to move the DNA around
  - You have 23 pairs of chromosomes (total of 46)
    - After replication, that's a lot of DNA that needs to move!

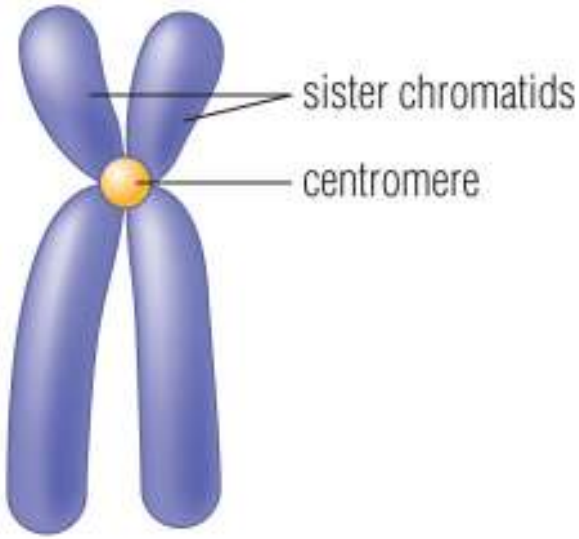


Mitosis – Summary of Key events

- DNA coils from chromatin into chromosomes
- Nucleus dissolves
- Mitotic spindle forms (spindle fibers and centrosomes) and fibers attach to chromosome centromeres
- Chromosomes line up on equator of the cell
- Sister chromatids are separated and move to opposite ends of the cell
- 2 nuclei form, spindle goes away and chromosomes become chromatin again

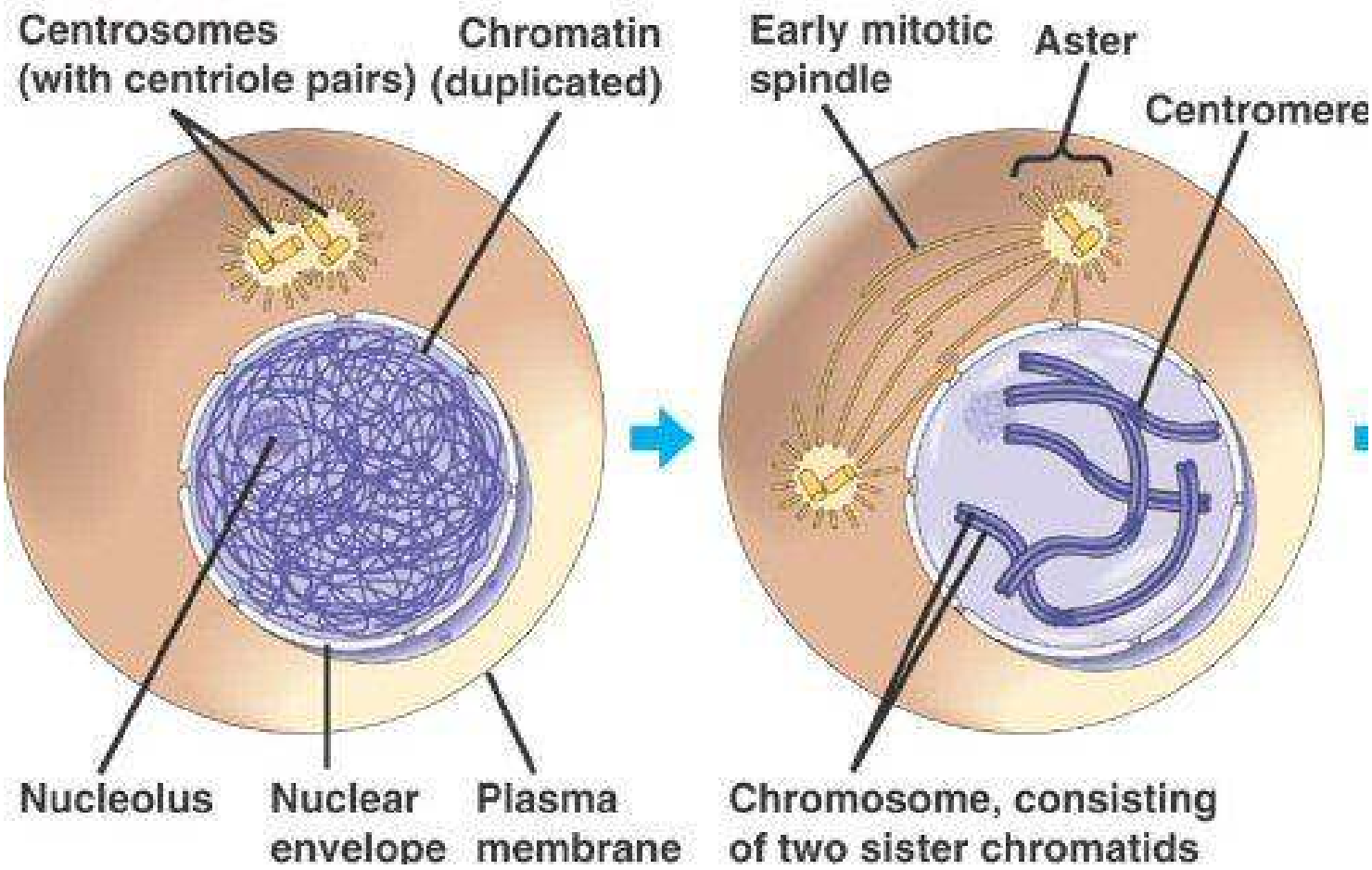
The end … but here's some more detail and some visuals

- As you go through the next few slides to see the illustrated summary, here are some words to help you.
  - Chromatin- DNA when it is uncoiled
  - Chromosome- coiled up DNA
  - Sister chromatids - DNA replication produces 2 copies of the exact same chromosome and the 2 copies stay together like this picture. One side is exactly the same as the other side



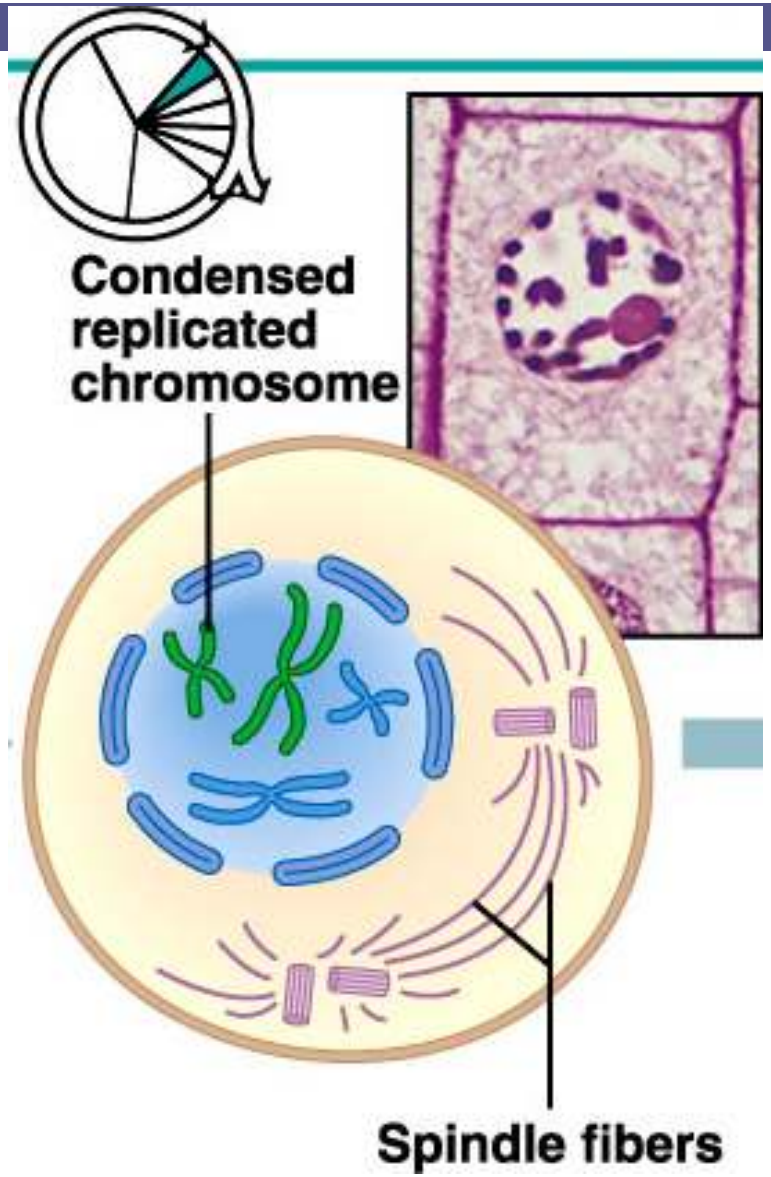
Mitosis- Key events

- DNA coils from chromatin into chromosomes



Mitosis- Key events

- Nucleus dissolves



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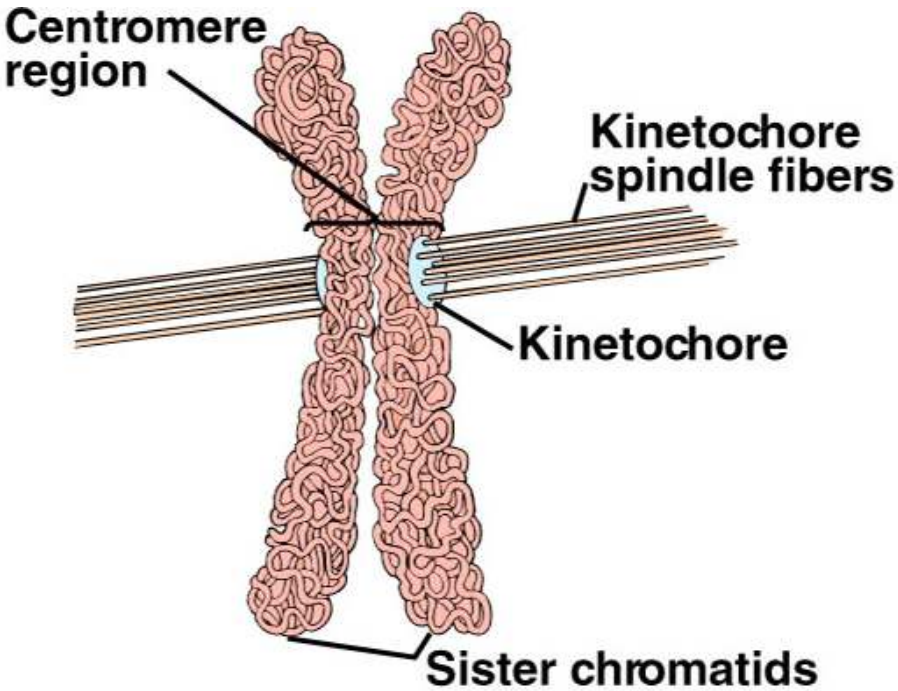
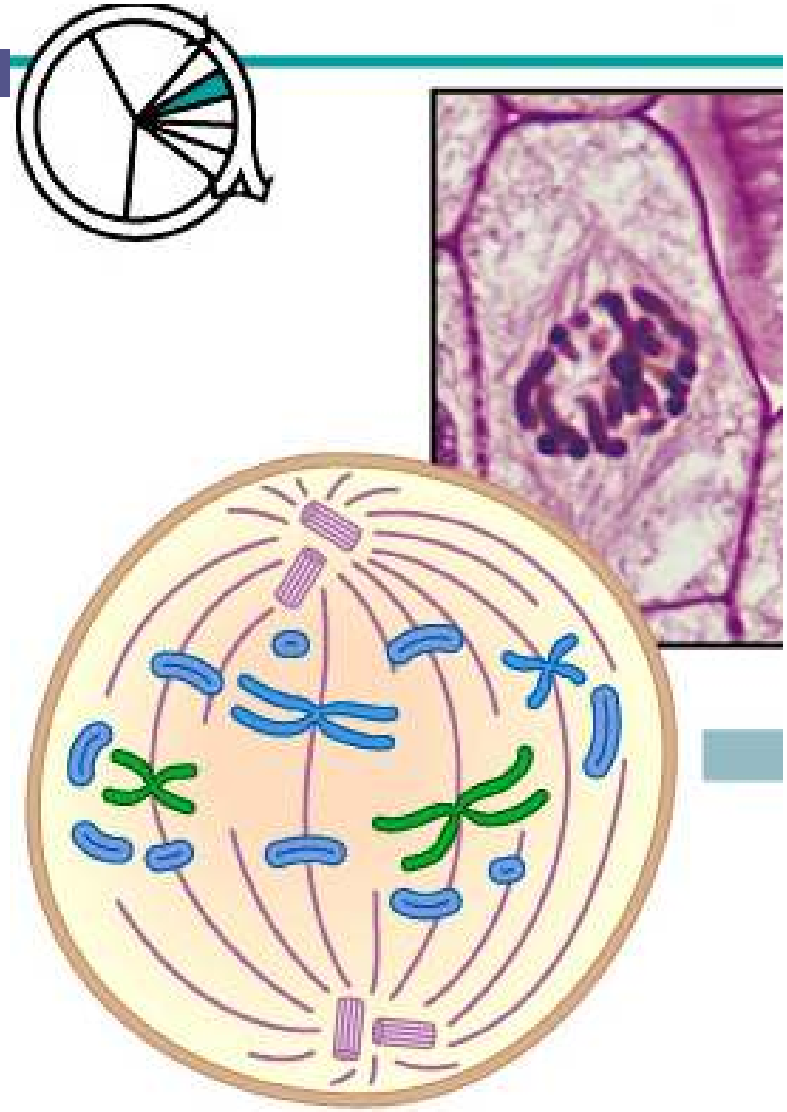
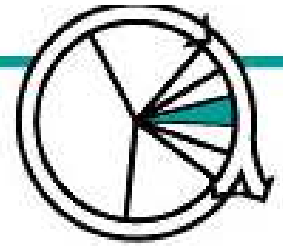
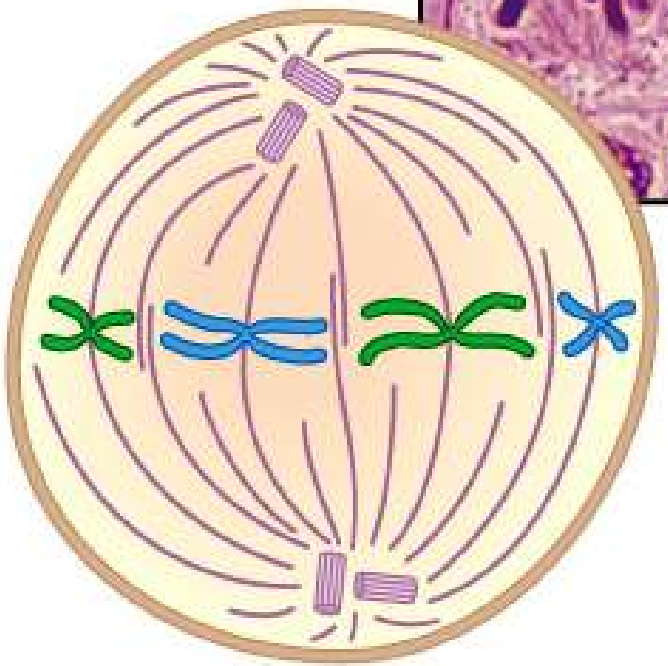




Mitosis: Key events

- Chromosomes line up on equator of the cell

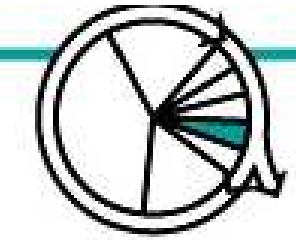


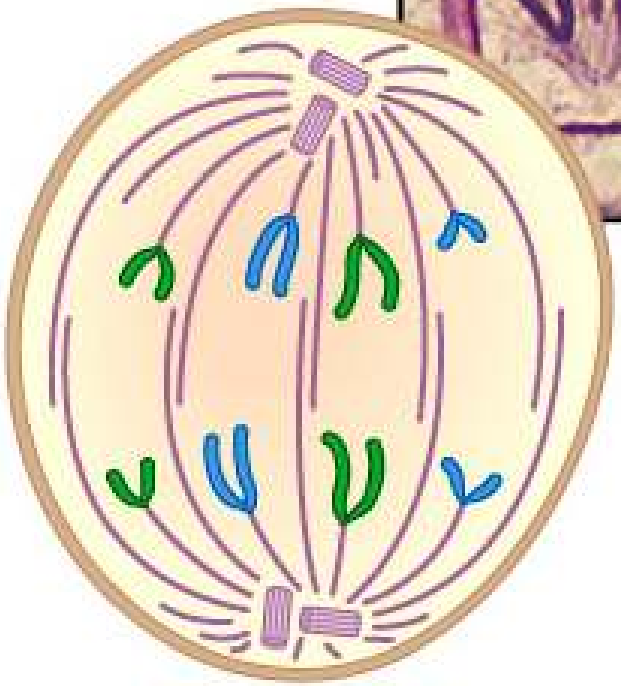


Mitosis: Key events

- Sister chromatids are separated and move to opposite ends of the cell

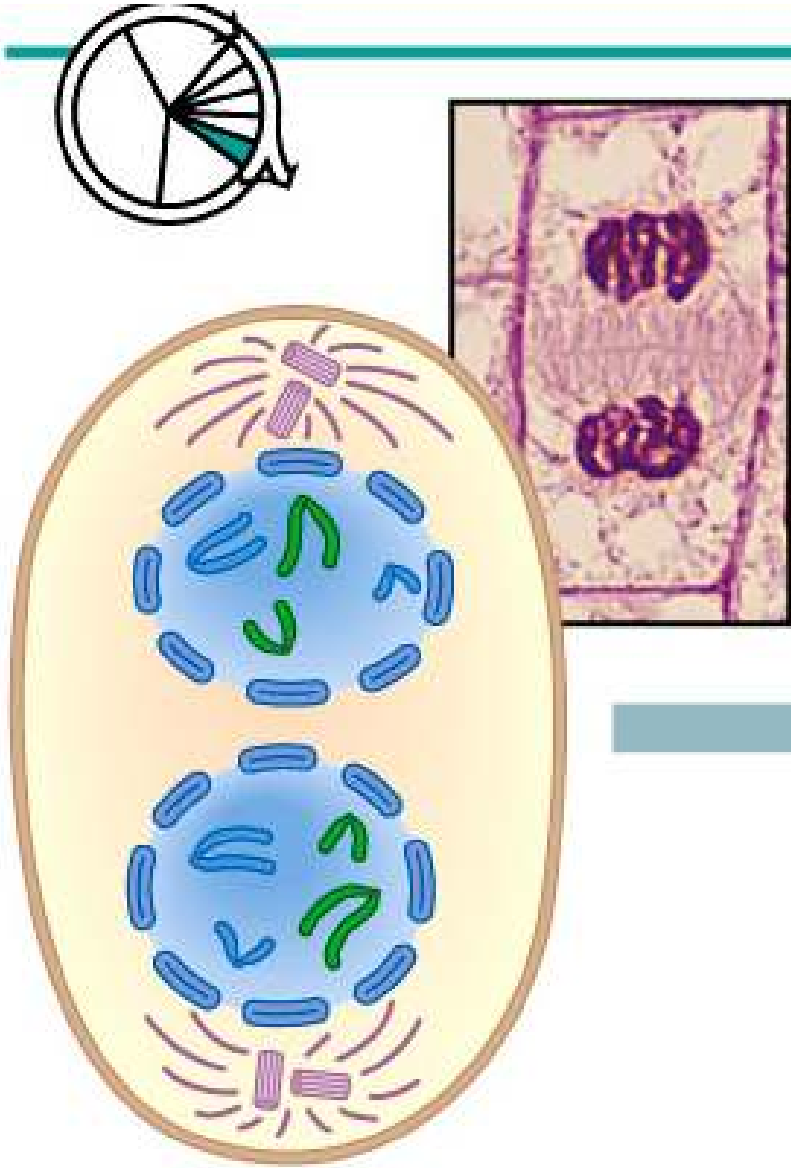
- Once separated, each sister is referred to as a chromosome





Mitosis: Key events

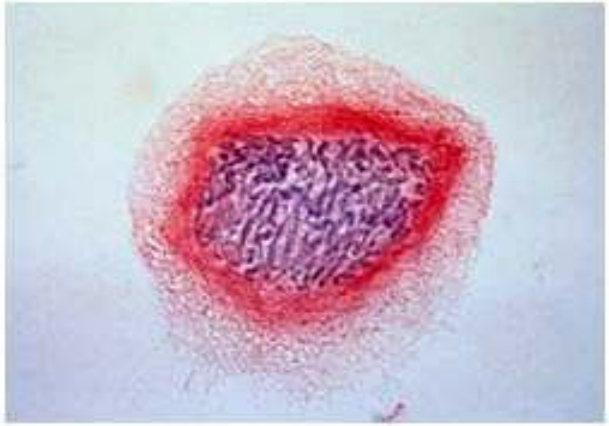
- 2 nuclei form, spindle goes away and chromosomes become chromatin again



Incase you were wondering

- These events have been grouped into stages by scientists
  - Prophase
  - Metaphase
  - Anaphase
  - Telophase
- The names are nice but the idea of set stages is a human construct
- Don't worry about the names –it's a continuous process with 3 main ideas:
  - Chromosomes are replicated, then lined up, then separated. That way, each final cell ends up with the right amount of DNA

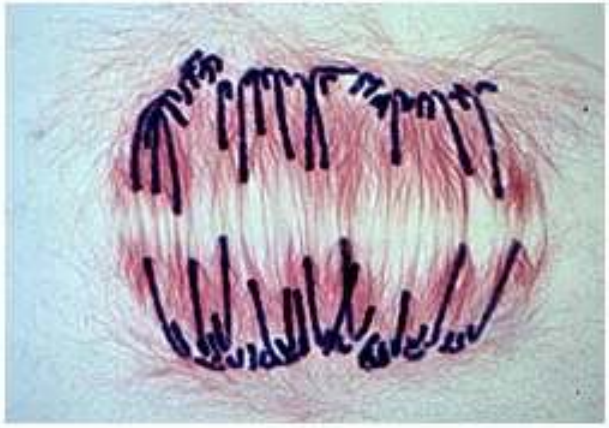
Interphase



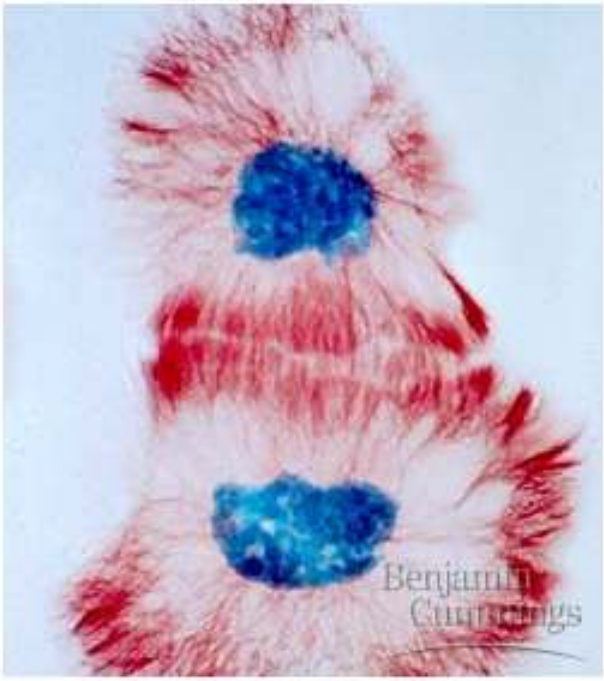
Prophase

Prometaphase

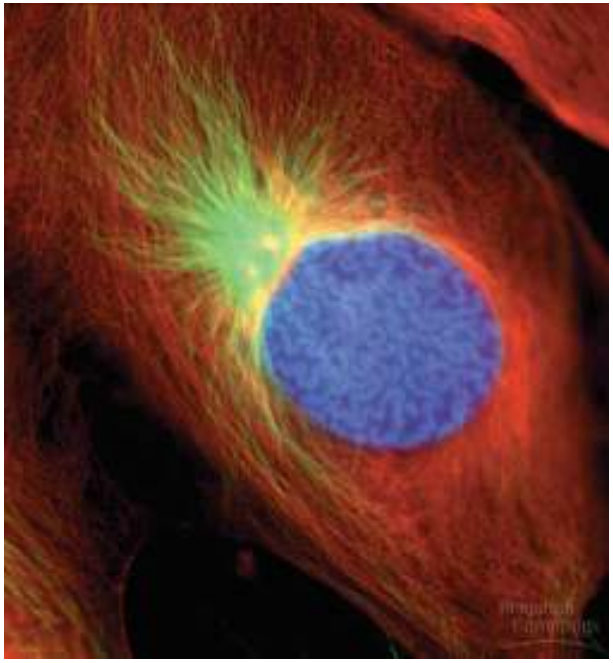
Metaphase

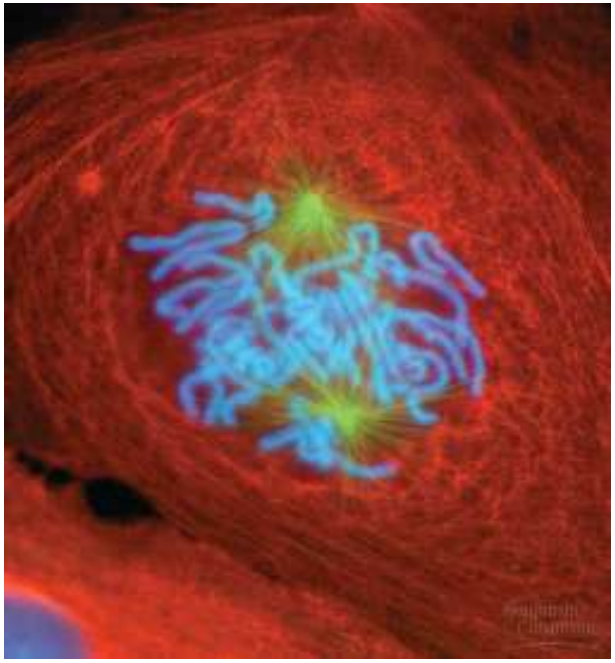


Anaphase



Telophase


Benjamin
Cummings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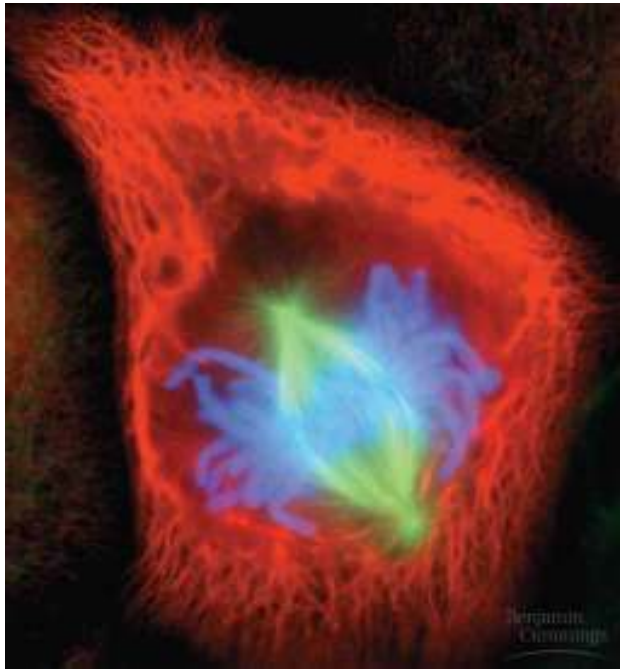
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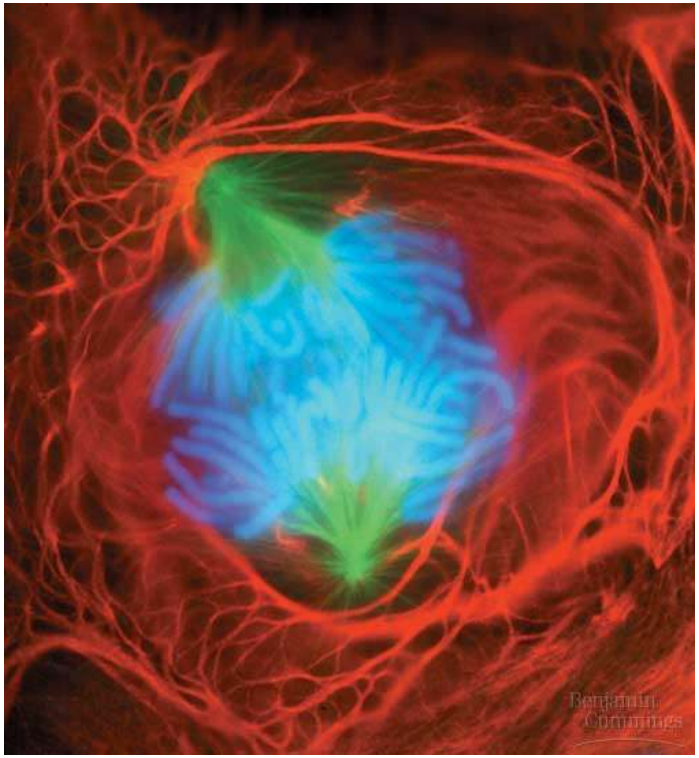
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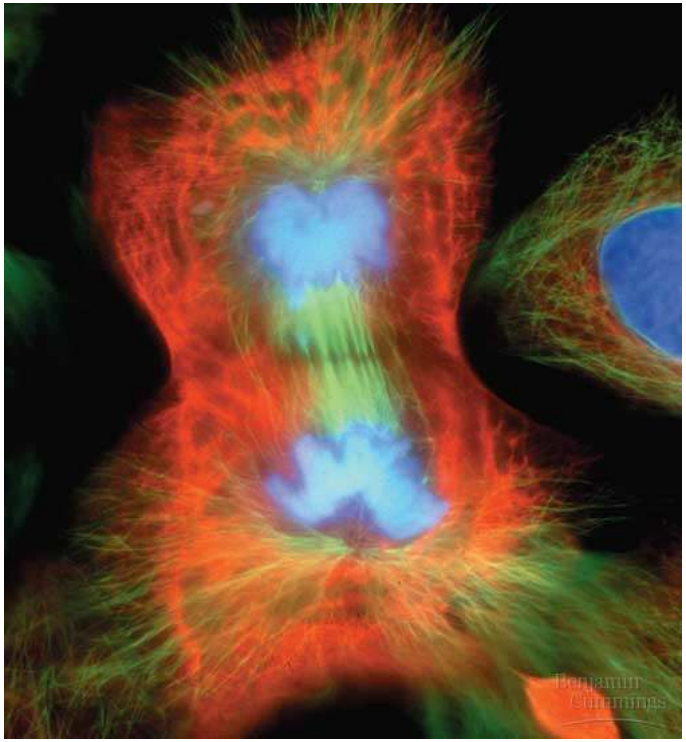
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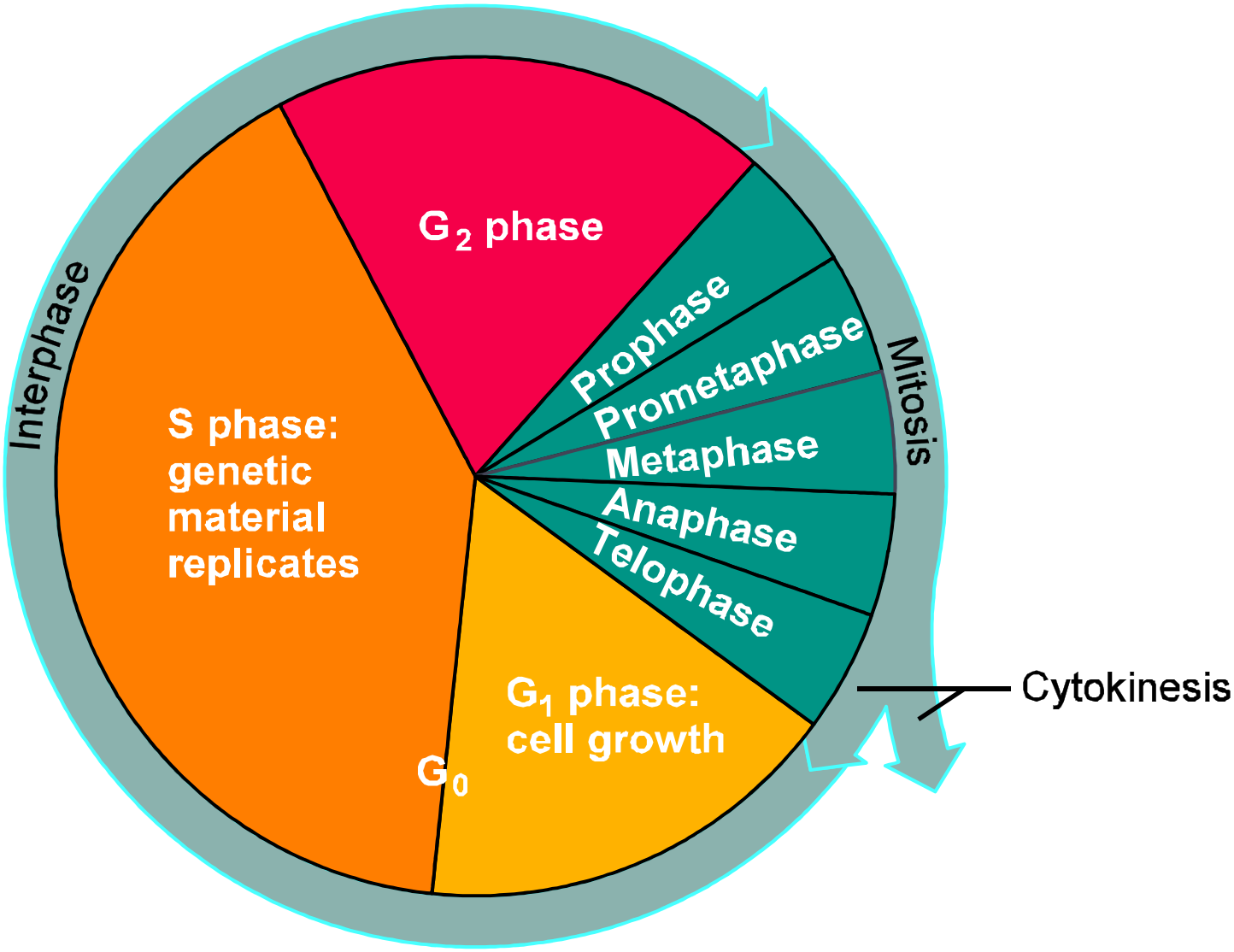
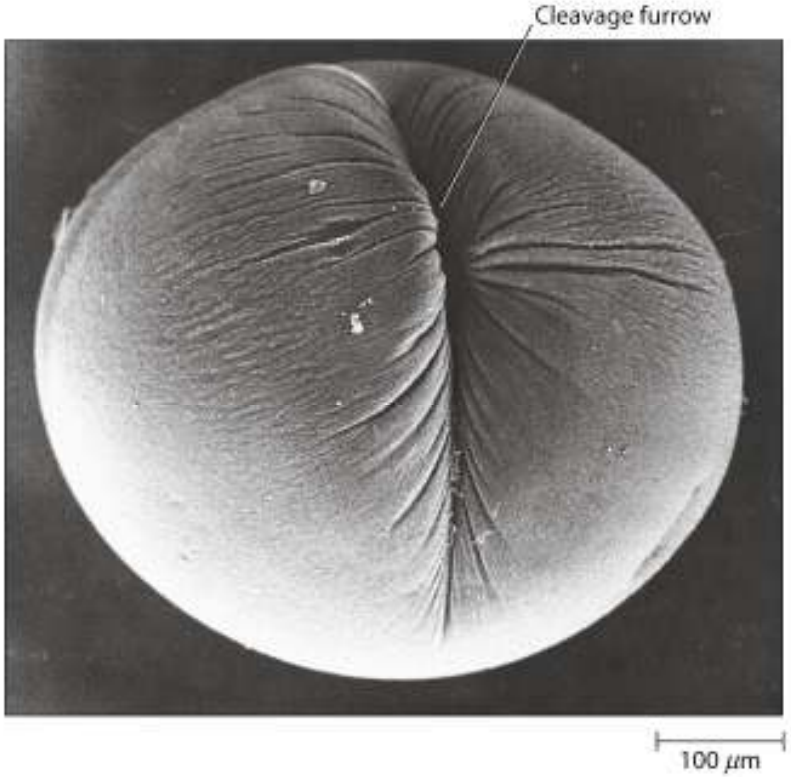

Interphase
S phase:
genetic
material
replicates
G_2 phase
Prophase
Prometaphase
Metaphase
Anaphase
Telophase
Mitosis
Cytokinesis
G_1 phase:
cell growth
G_0

Cytokinesis

- When mitosis is over, cytokinesis begins
- Splitting of the cytoplasm to form 2 cells
  - 2 daughter cells appear
- Different in plants and animals

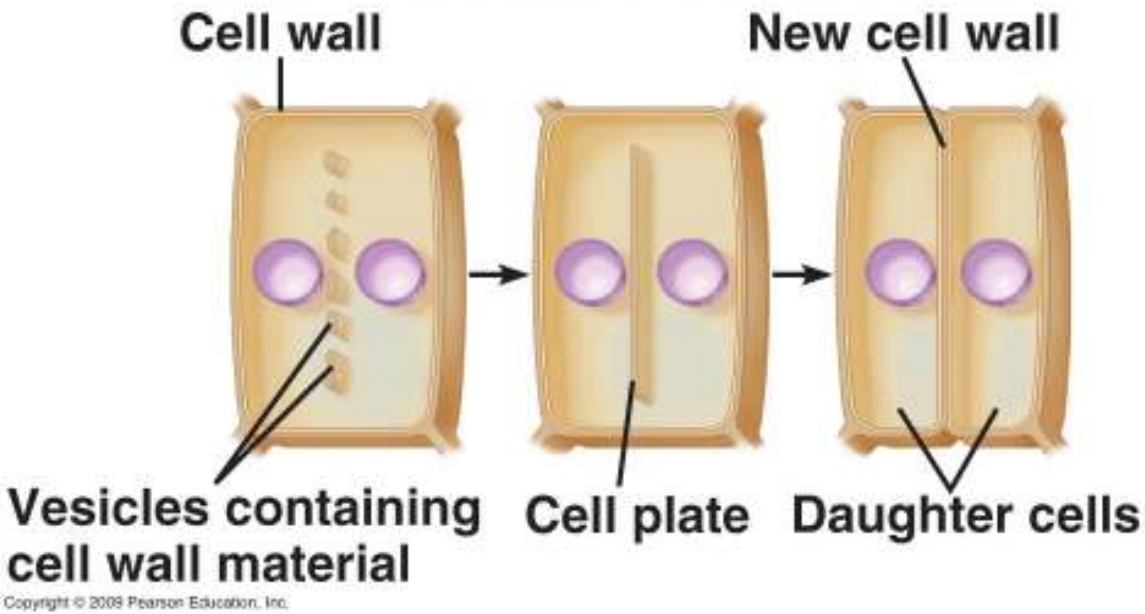
Cytokinesis in animal cells

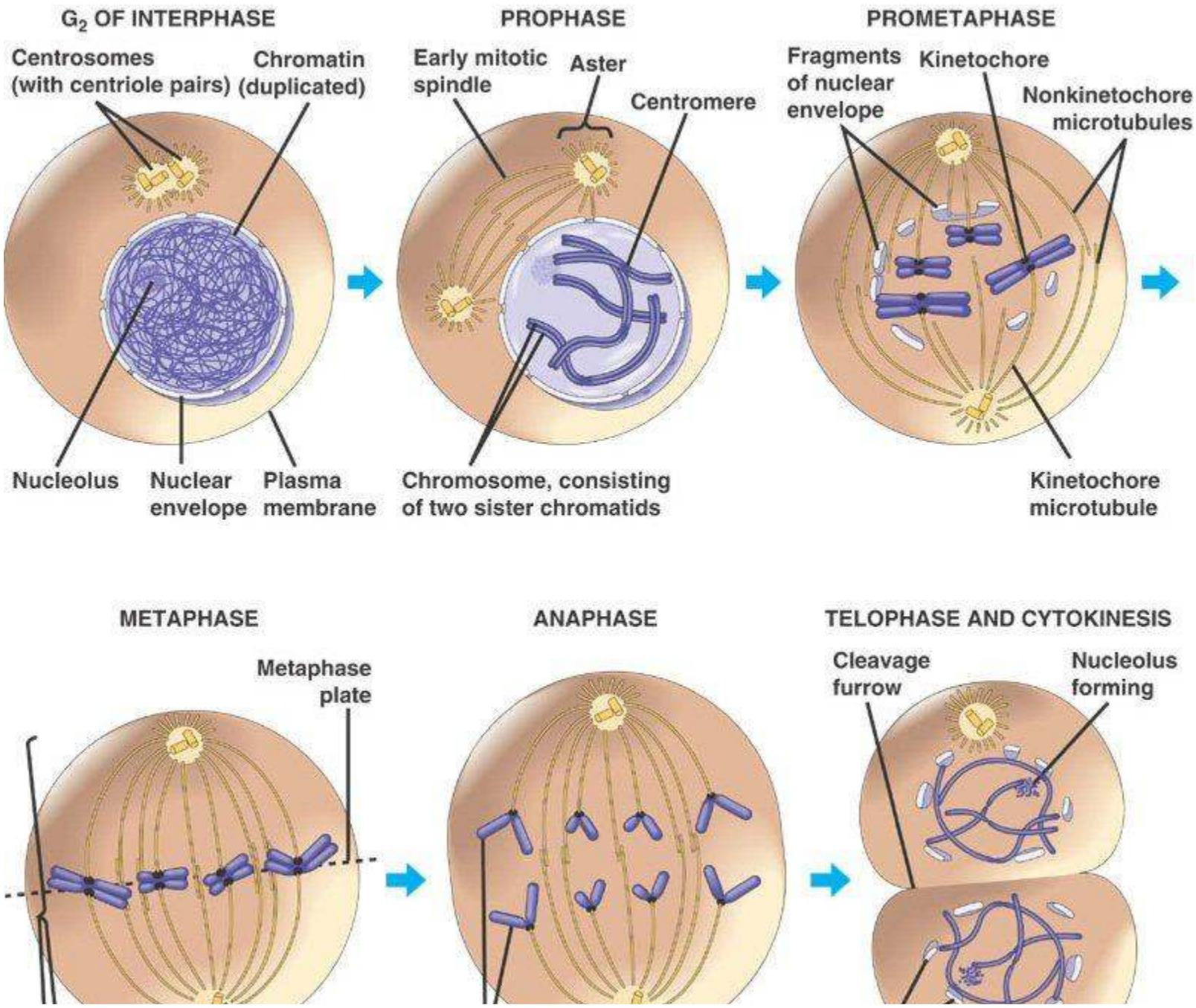
- Cleavage
- Cleavage furrow (indentation) forms along metaphase plate
- Actin and myosin filaments contract, pinching cell in half



Cytokinesis in plant cells

- Plant cells have a cell wall
- Vesicles carry material to the center of the cell where the cell plate is formed
- Cell plate grows until it fuses with the existing membrane, dividing the cells
- Cell plate turns into a new cell wall




G2 OF INTERPHASE
Centrosomes (with centriole pairs)
Chromatin (duplicated)
Nucleolus
Nuclear envelope
Plasma membrane
PROPHASE
Early mitotic spindle
Aster
Centromere
Chromosome, consisting of two sister chromatids
PROMETAPHASE
Fragments of nuclear envelope
Kinetochore
Nonkinetochore microtubules
Kinetochore microtubule
METAPHASE
Metaphase plate
ANAPHASE
TELOPHASE AND CYTOKINESIS
Cleavage furrow
Nucleolus forming

How do chromosomes move?

- Motor proteins in the kinetochore chew up the microtubules and move towards the poles