

McGraw-Hill Ryerson

BC Science CONNECTIONS



BC Science Connections 9

**Unit 1: The continuity of life depends on cells being
derived from cells**

Topic 1.2: What are different ways that living things reproduce asexually?

- Bacteria reproduce by binary fission.
- All eukaryotic cells reproduce by the cell cycle.
- Yeasts reproduce by budding.
- Moulds reproduce using spores.
- Plants have many ways to reproduce asexually.



Concept 2: All eukaryotic cells reproduce by the cell cycle.

Purpose of cell division:

- Replace older cells
- Replace damaged cells
- Produce new offspring in single-celled organisms (amoebas)



Figure 1.8: A scab forms as some of the remaining skin cells beneath the wound reproduce repeatedly to form a new skin layer to replace what was scraped away.

Reproduction and the Cell Cycle

The **cell cycle** has two stages:

1. Growth and development

- Interphase (replication of DNA, regular cell activities)

2. Cell division

- Mitosis (division of nucleus)
- Cytokinesis (division of cytoplasm and cell membrane)

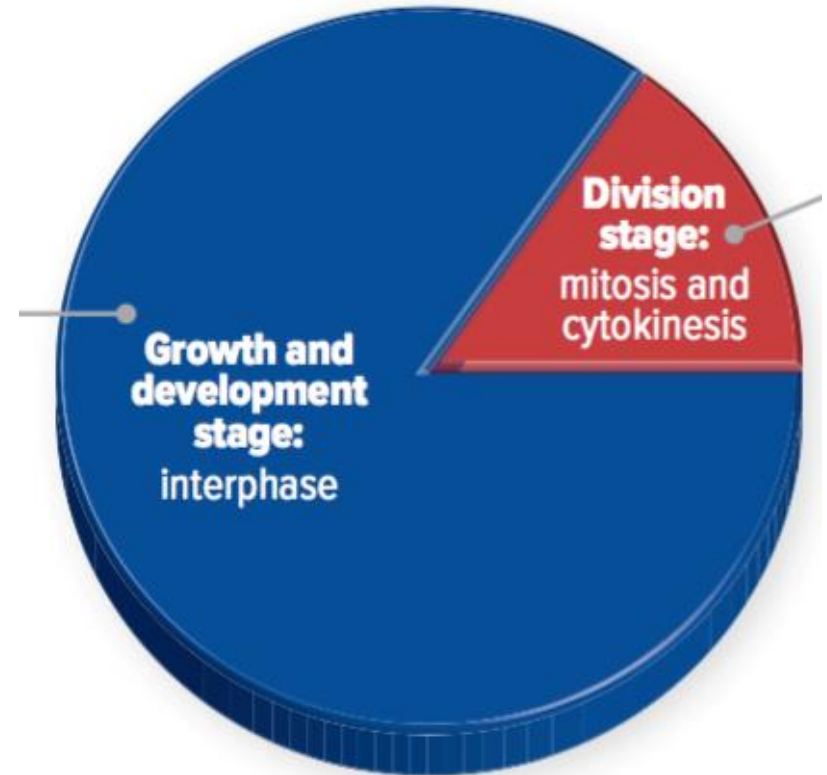
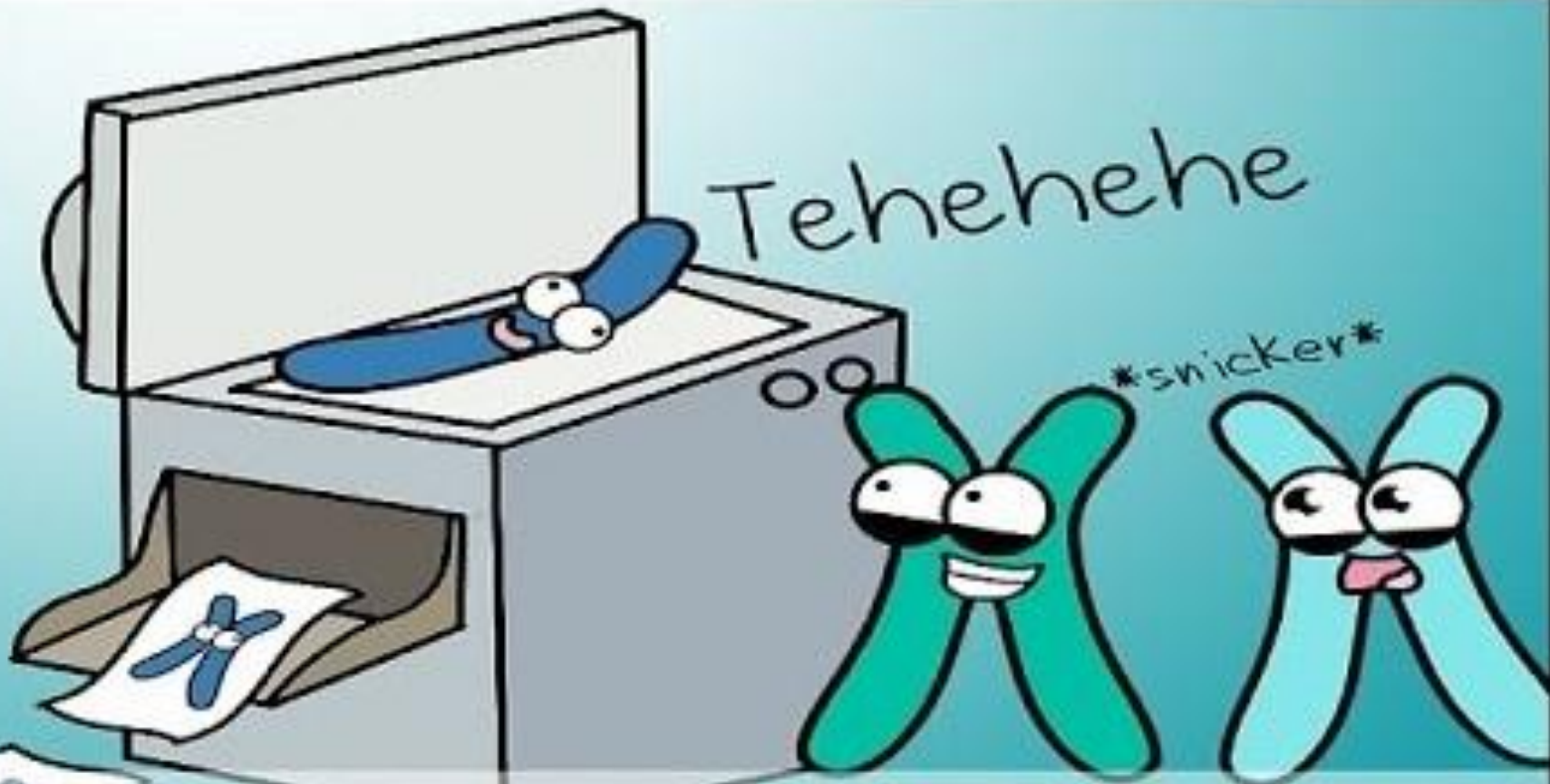
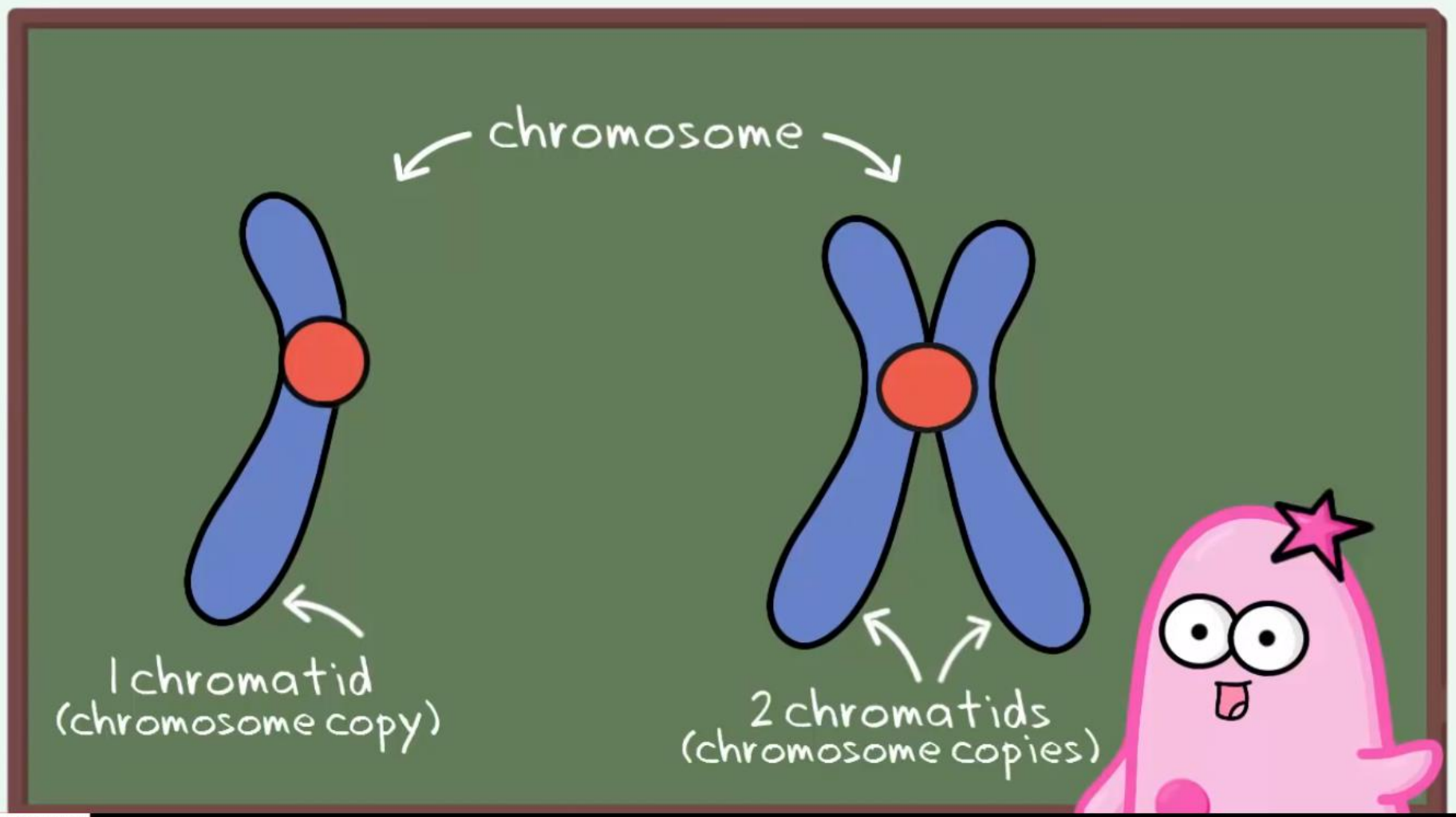


Figure 1.10: The cell cycle.



Chromosome Numbers During Cell Division

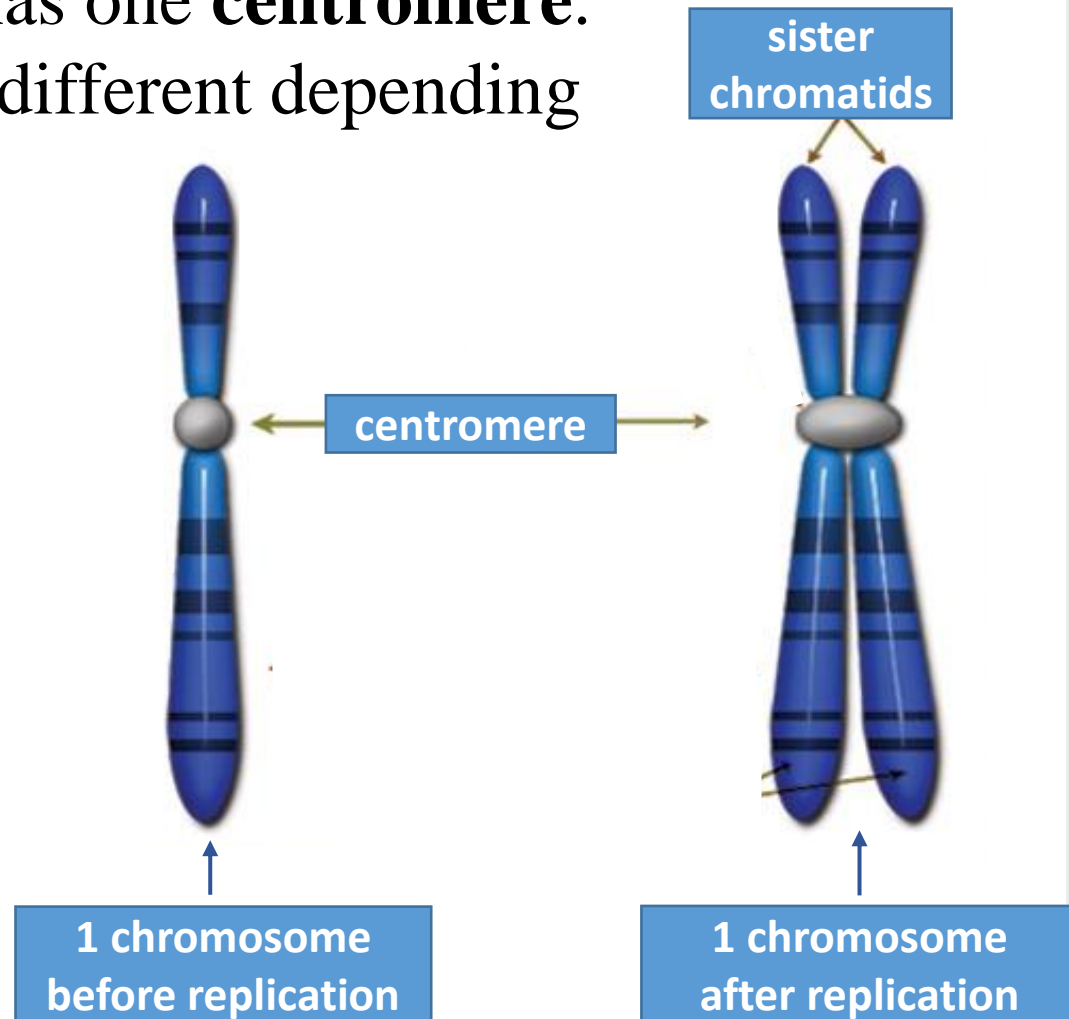
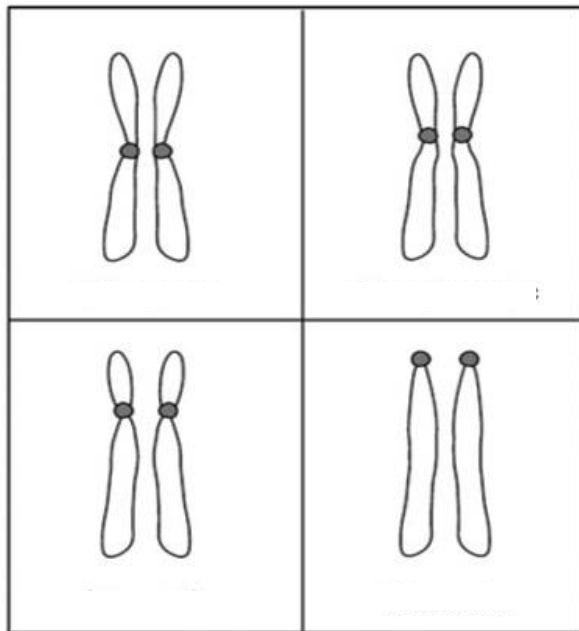
With the Amoeba Sisters



» Auto Replay

Chromosomes Elaborations (not in textbook)

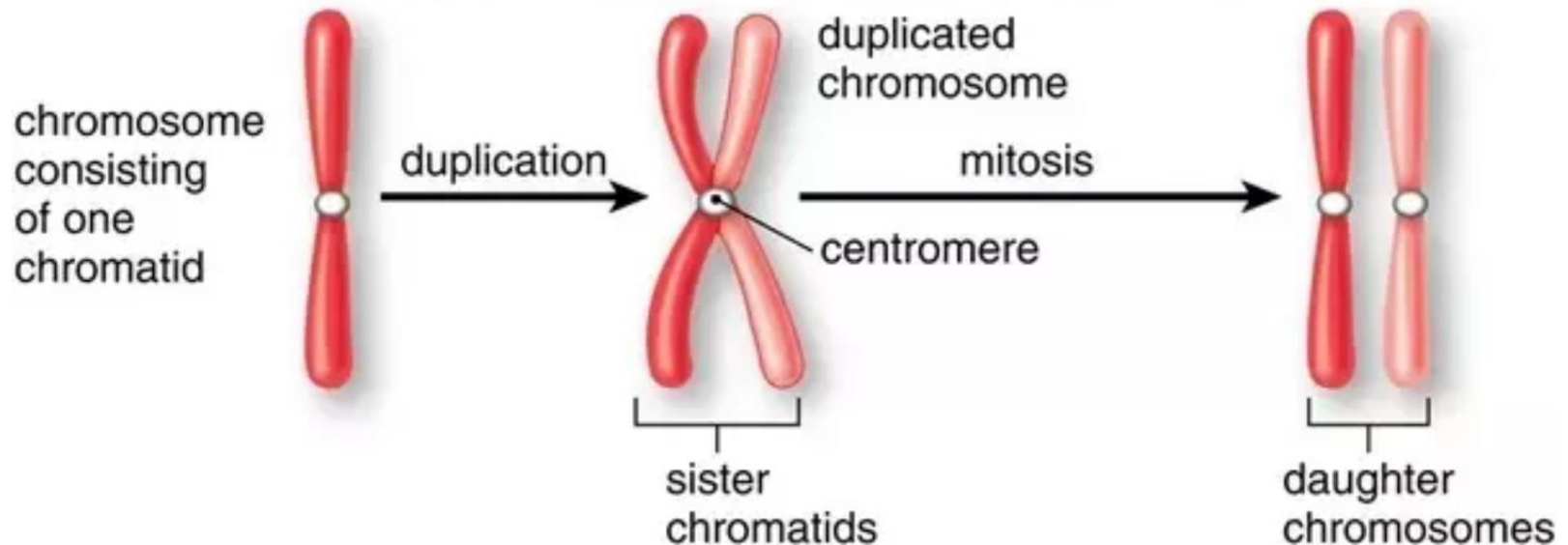
- Each chromosome has one **centromere**.
- Chromosomes look different depending on whether DNA has been copied yet.



Chromosomes Elaborations (not in textbook)

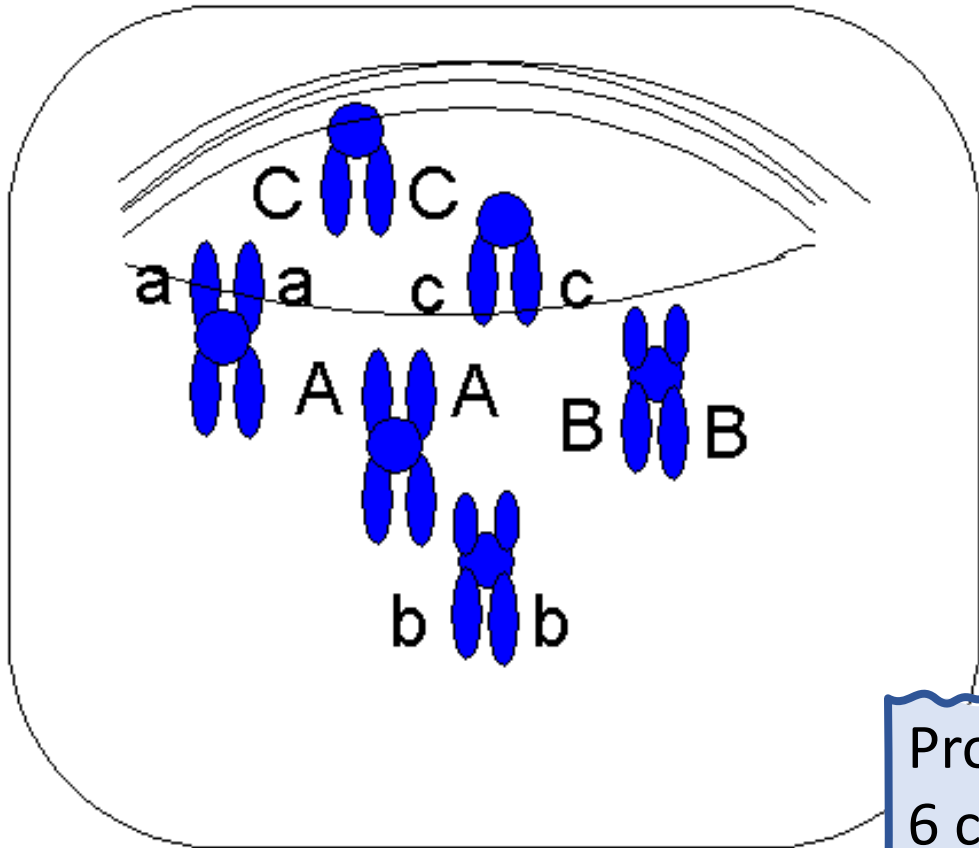
Chromatid: a complete (double helix) copy of the DNA sequence that is on one chromosome

Sister chromatids: *identical* chromatids (same DNA sequence); formed by replication during interphase



How many chromosomes in each stage? How many chromatids?

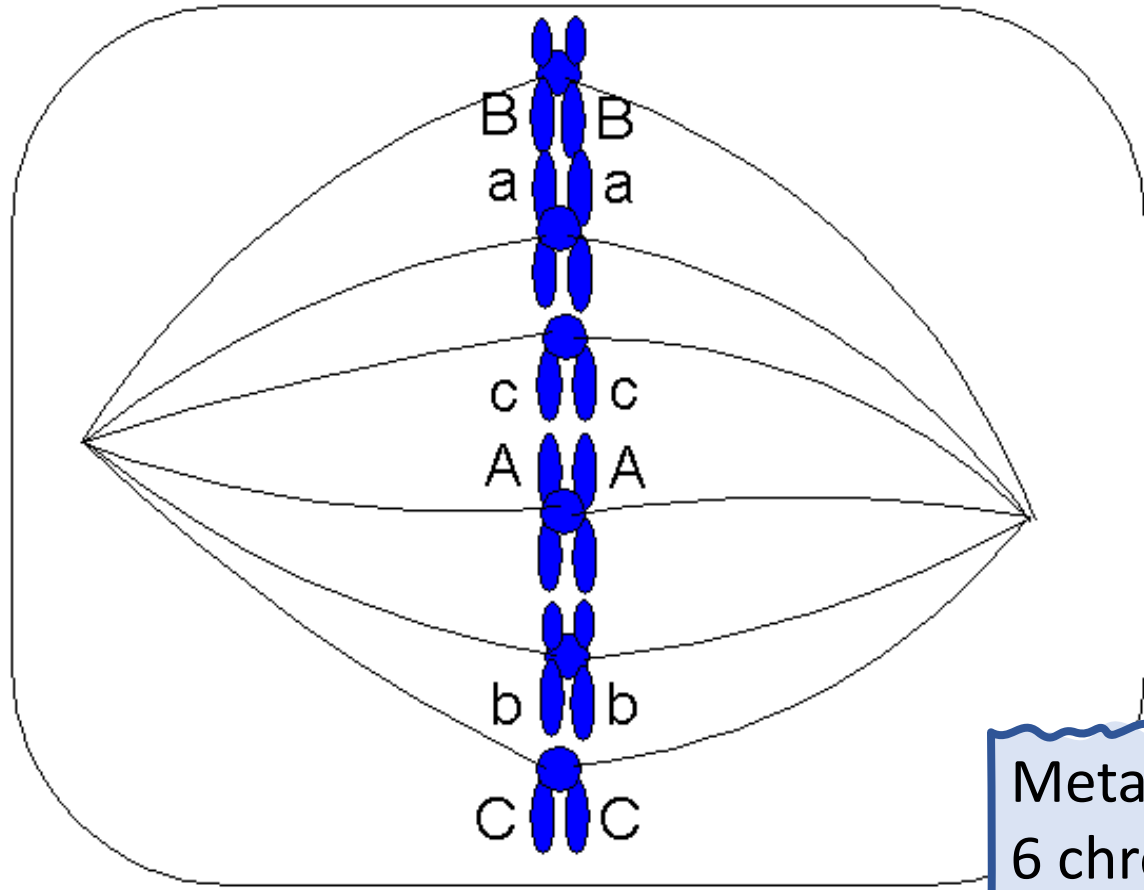
What phase? How many chromosomes? How many chromatids?



Prophase*
 6 chromosomes
 12 chromatids

<https://datbootcamp.com/biology-strategy/chromosome-and-chromatid-numbers-during-mitosis-and-meiosis/>

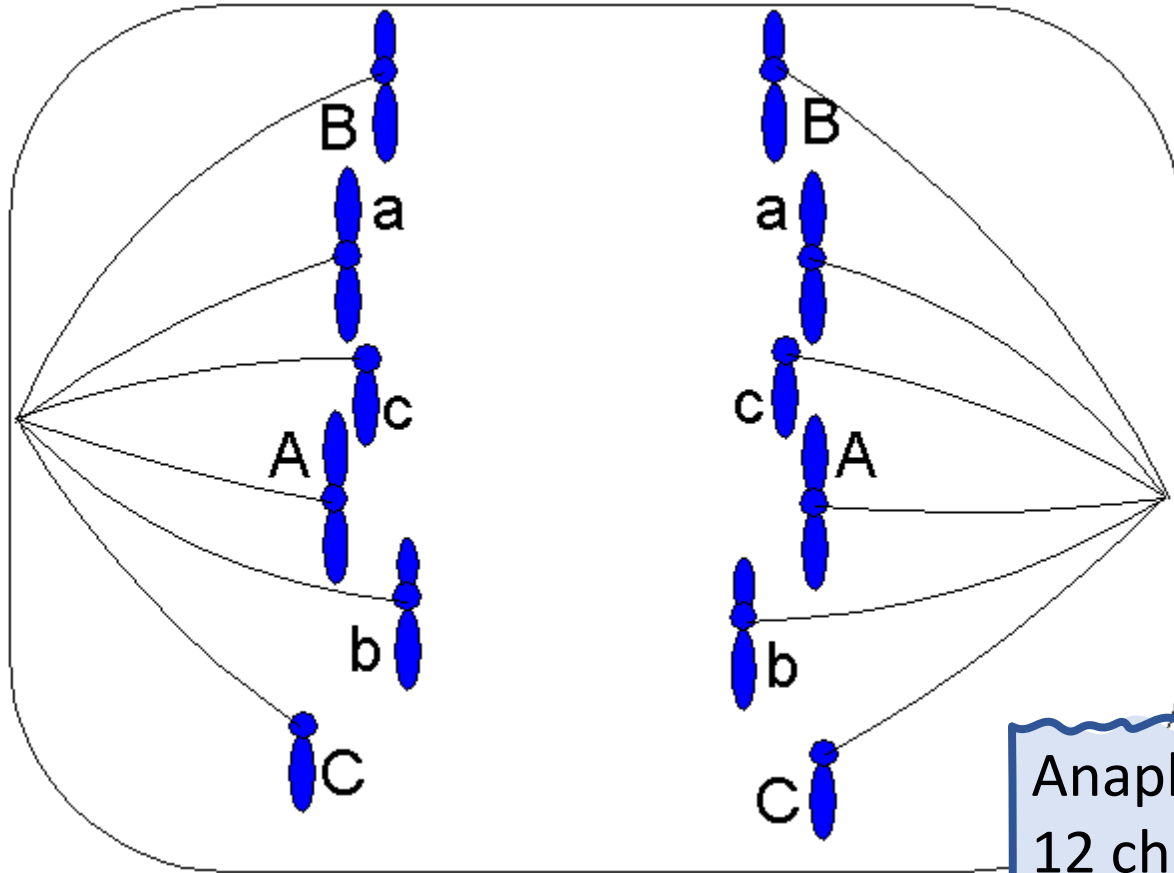
What phase? How many chromosomes? How many chromatids?



Metaphase
6 chromosomes
12 chromatids

<https://datbootcamp.com/biology-strategy/chromosome-and-chromatid-numbers-during-mitosis-and-meiosis/>

What phase? How many chromosomes? How many chromatids?

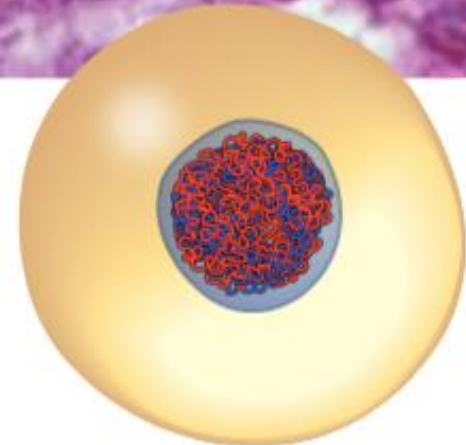
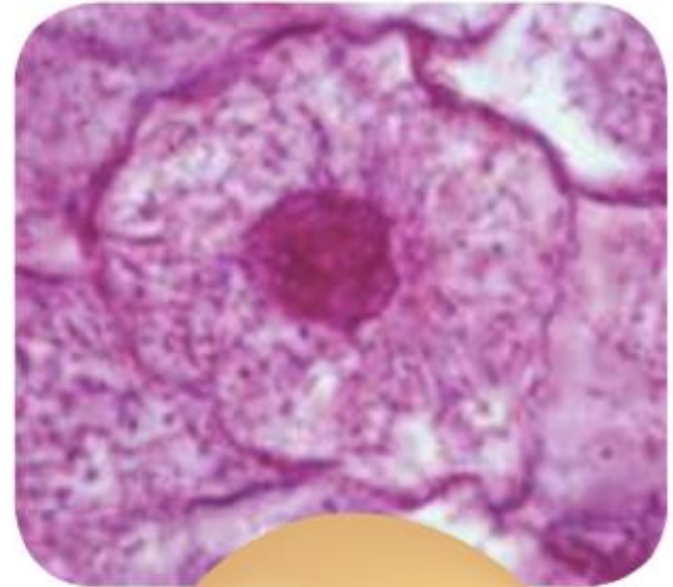
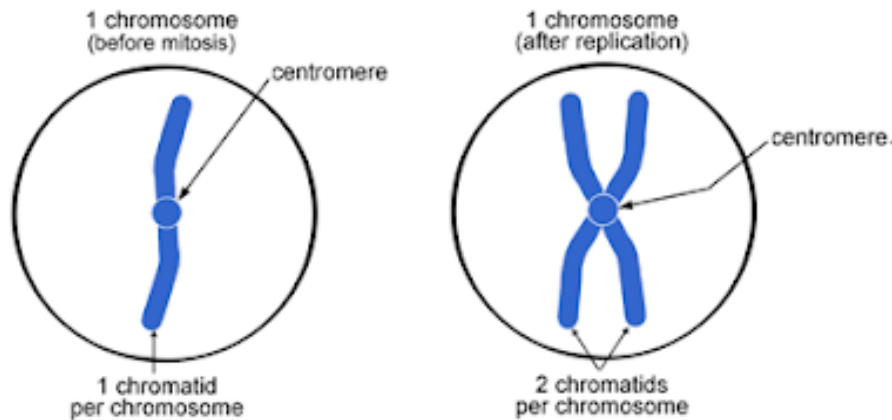


Anaphase
 12 chromosomes
 12 chromatids

<https://datbootcamp.com/biology-strategy/chromosome-and-chromatid-numbers-during-mitosis-and-meiosis/>

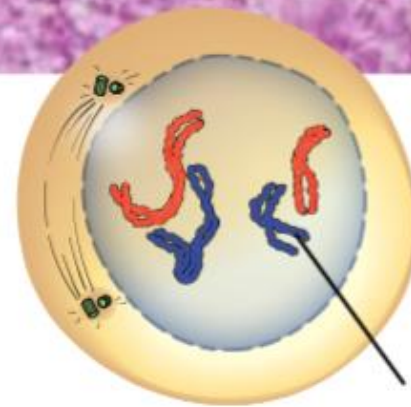
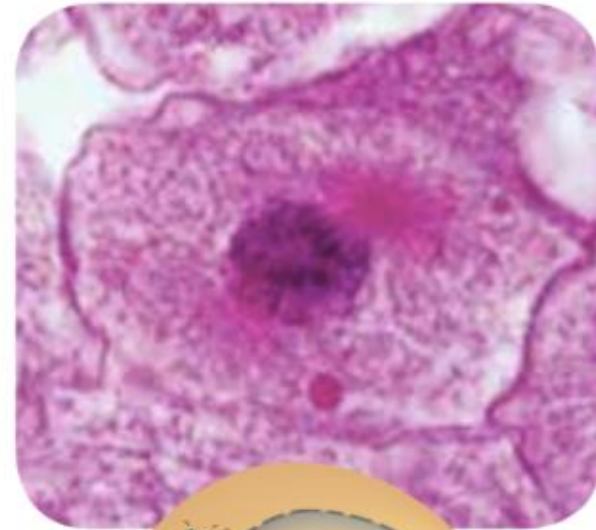
Growth and Development: Interphase

- Regular cell processes (growth, number of organelles increases)
- DNA (chromatin) is copied



Cell Division: Phase 1 of Mitosis (Prophase)

- **Nuclear membrane** begins to disappear
- **DNA condenses into chromosomes**



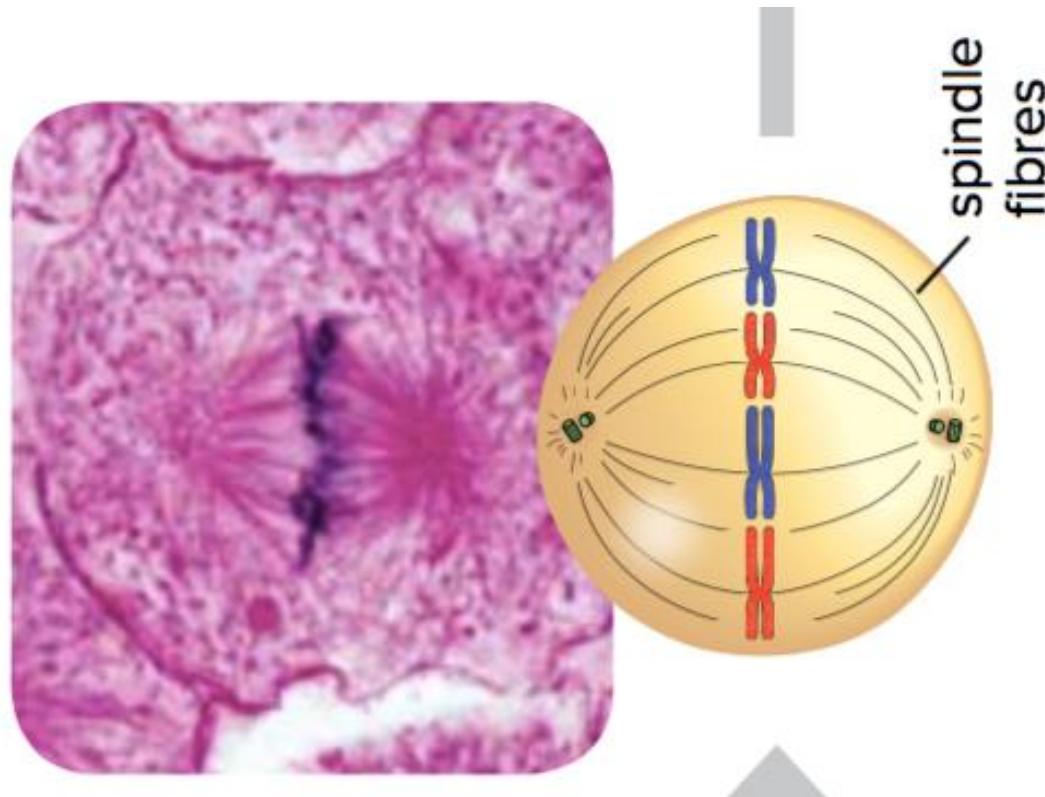
Note about diagram:

Red chromosomes from mom; blue chromosomes from dad

Each pair of chromosomes with the same shape and length contains the same gene locations: they are a homologous pair of chromosomes.

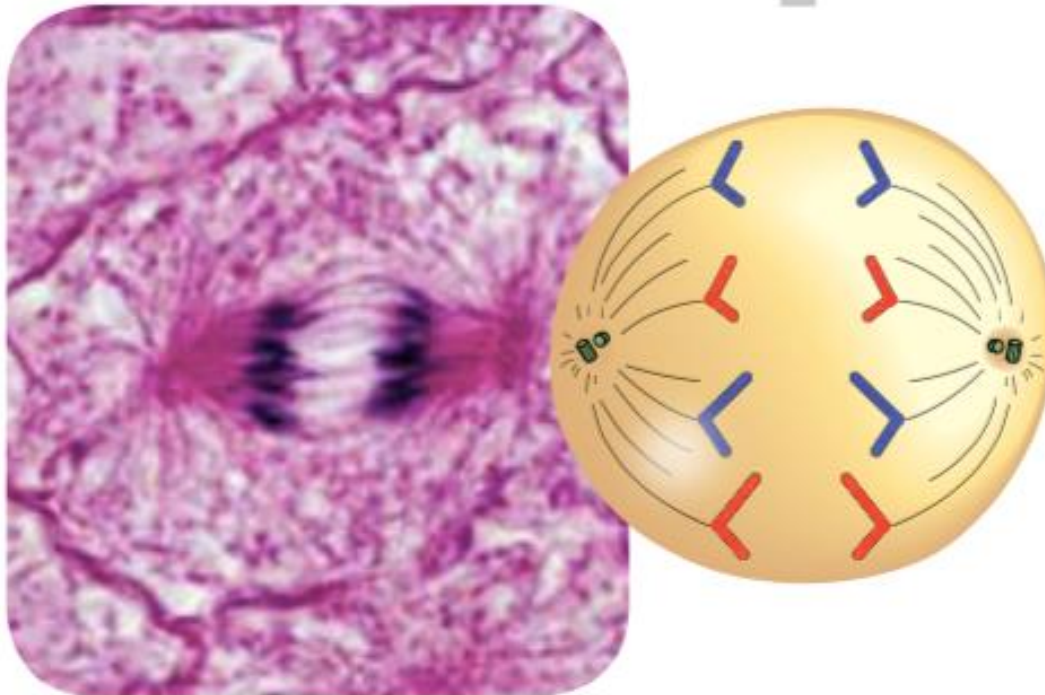
Cell Division: Phase 2 of Mitosis (Metaphase)

- **Spindle fibres** attach to chromosome **centromeres**
- Spindle fibers pull chromosomes to the middle of the cell



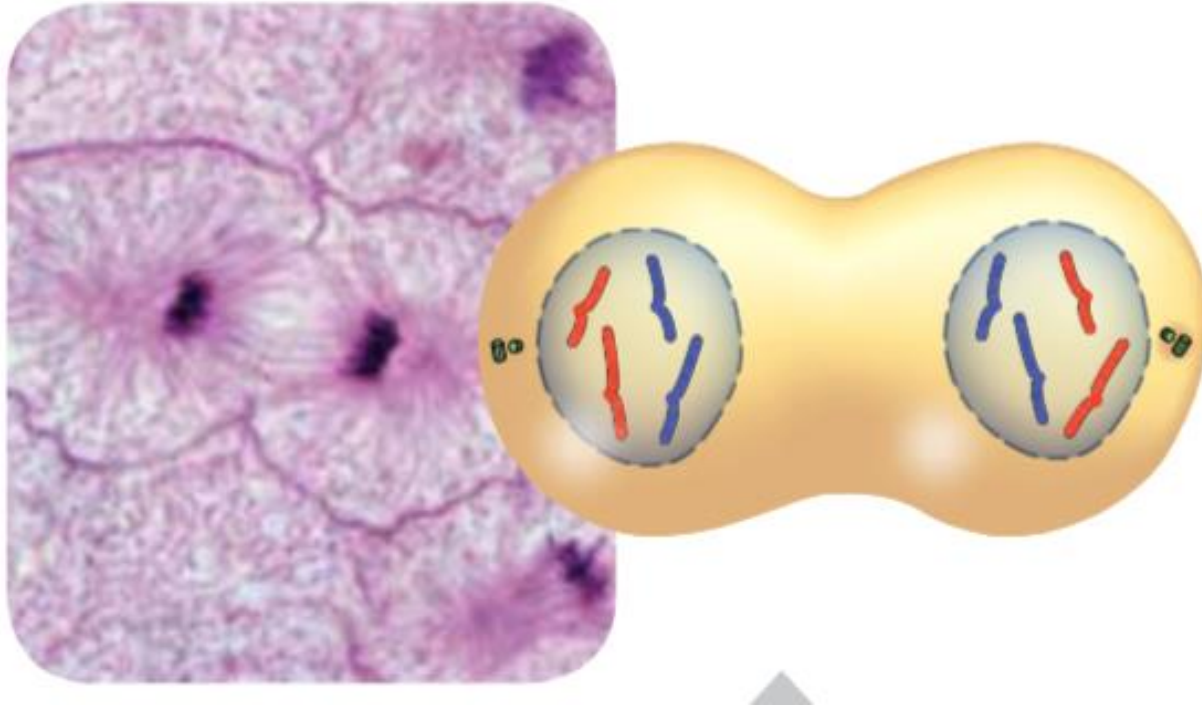
Cell Division: Phase 3 of Mitosis (Anaphase)

- Spindle fibers pull chromosomes apart
- **Sister chromatids** go to each end of the cell



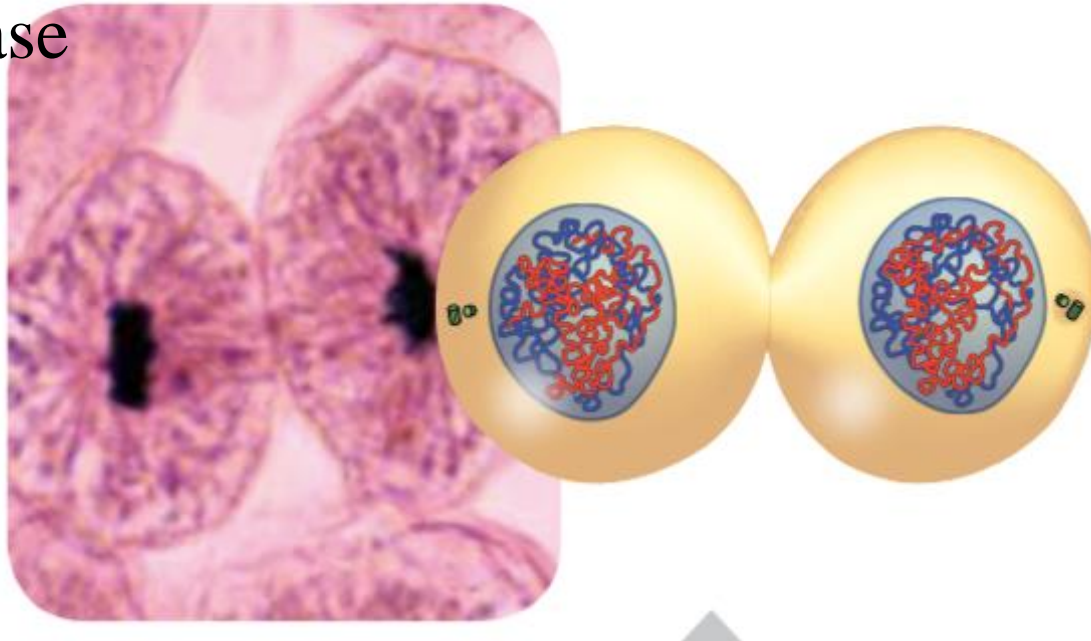
Cell Division: Phase 4 of Mitosis (Telophase)

- New nuclear envelopes form around each set of chromosomes



Cell Division: Cytokinesis

- Cytoplasm and organelles are divided
- New cell membrane (and cell wall in plant cells) forms between daughter cells
- DNA unravels to form chromatin, as the cell enters interphase



Cell Cycle Summary: Overall

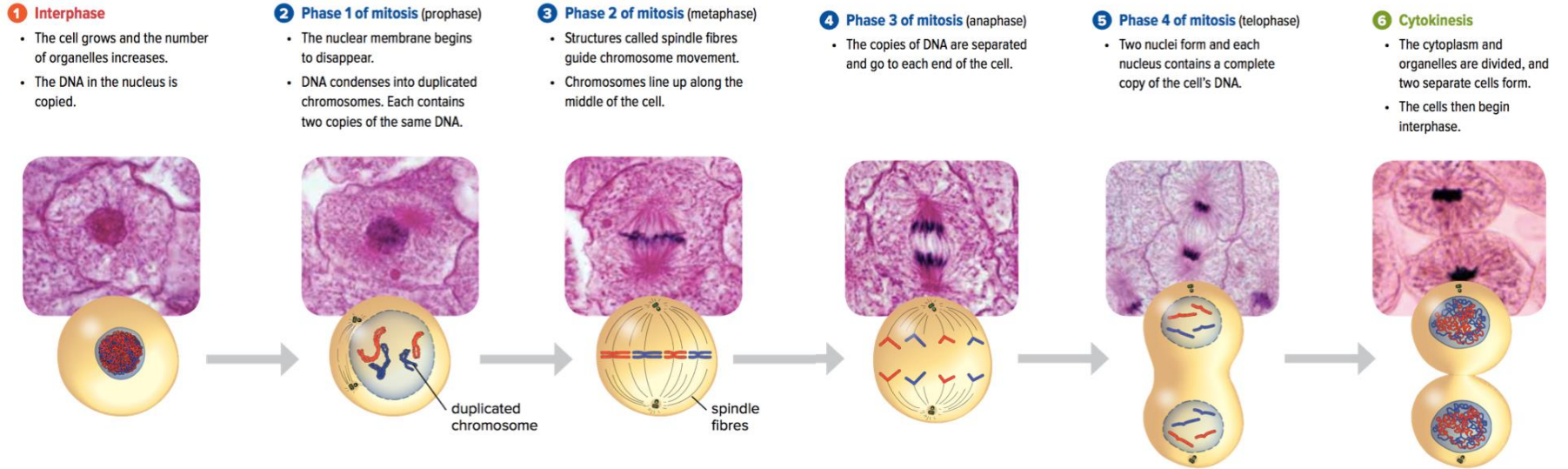
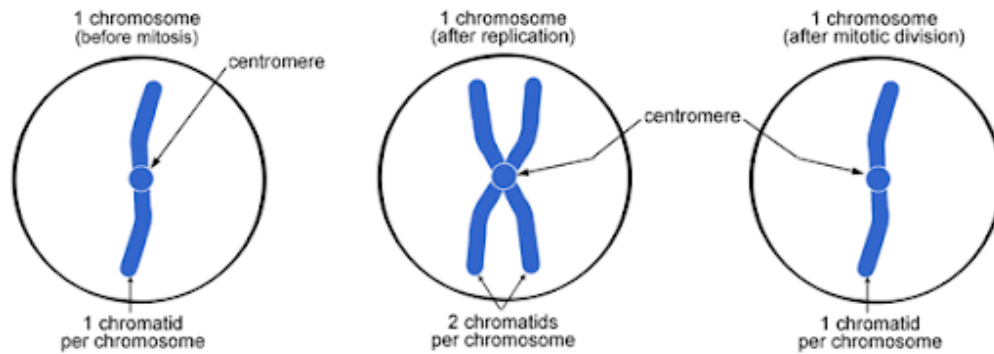


Figure 1.9: Cell reproduction by mitosis results in daughter cells that are genetically identical to each other and to the parent cell.



http://cyberbridge.mcb.harvard.edu/mitosis_2.html

Cell Cycle Summary: Nucleus

Stage of the Cell Cycle	Nucleus
Interphase	✓
Mitosis: Prophase	Breaks down
Mitosis: Metaphase	X
Mitosis: Anaphase	X
Mitosis: Telophase	Reforms (2 nuclei)
Cytokinesis	✓

Cell Cycle Summary: DNA

Stage of the Cell Cycle	DNA Appearance	Extra Notes
Interphase	Chromatin	DNA replicates
Mitosis: Prophase	DNA condensing	2 chromatids per chromosome
Mitosis: Metaphase	Chromosome	/
Mitosis: Anaphase	Chromosome	Sister chromatids separate; 1 chromatid per chromosome
Mitosis: Telophase	Chromosome	/
Cytokinesis	Chromatin	Each nucleus has a complete set of DNA

Discussion Questions

1. What happens to the DNA in a cell during interphase? Why is this step important for the reproduction process?
2. In two or three sentences, describe what the cell cycle is.

Concept 1: Bacteria reproduce by binary fission.

Bacteria: Micro-organisms that exist as single prokaryotic cells

- Reproduce asexually by a process called **binary fission**

Note: binary fission occurs in **both** eukaryotic and prokaryotic organisms, but in eukaryotic organisms the process is simple mitosis.



Figure 1.6: Bacteria are in, on, and all around us. Bacteria is used in food production (left) and can cause disease, such as strep throat (right).

Reproduction by Binary Fission

Binary fission

- Type of asexual reproduction
- A parent cell splits into two individual, identical cells (daughter cells)
- Daughter cells have identical genetic information (DNA)

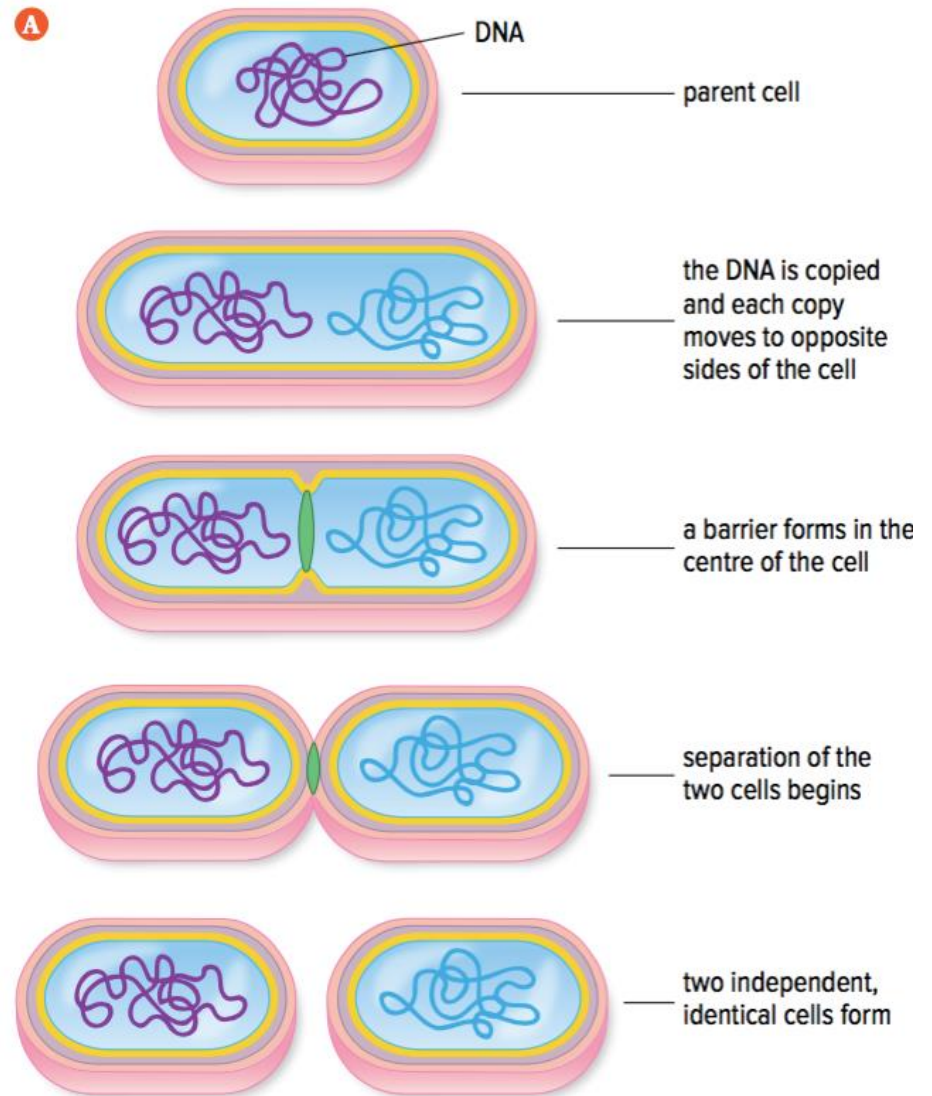


Figure 1.7: Binary fission

Reproduction by Binary Fission (continued)

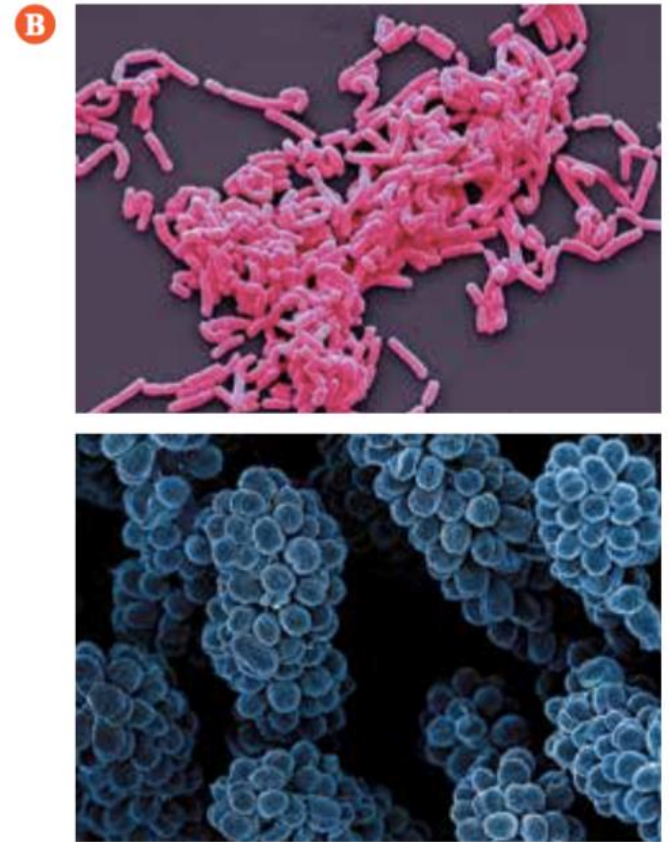
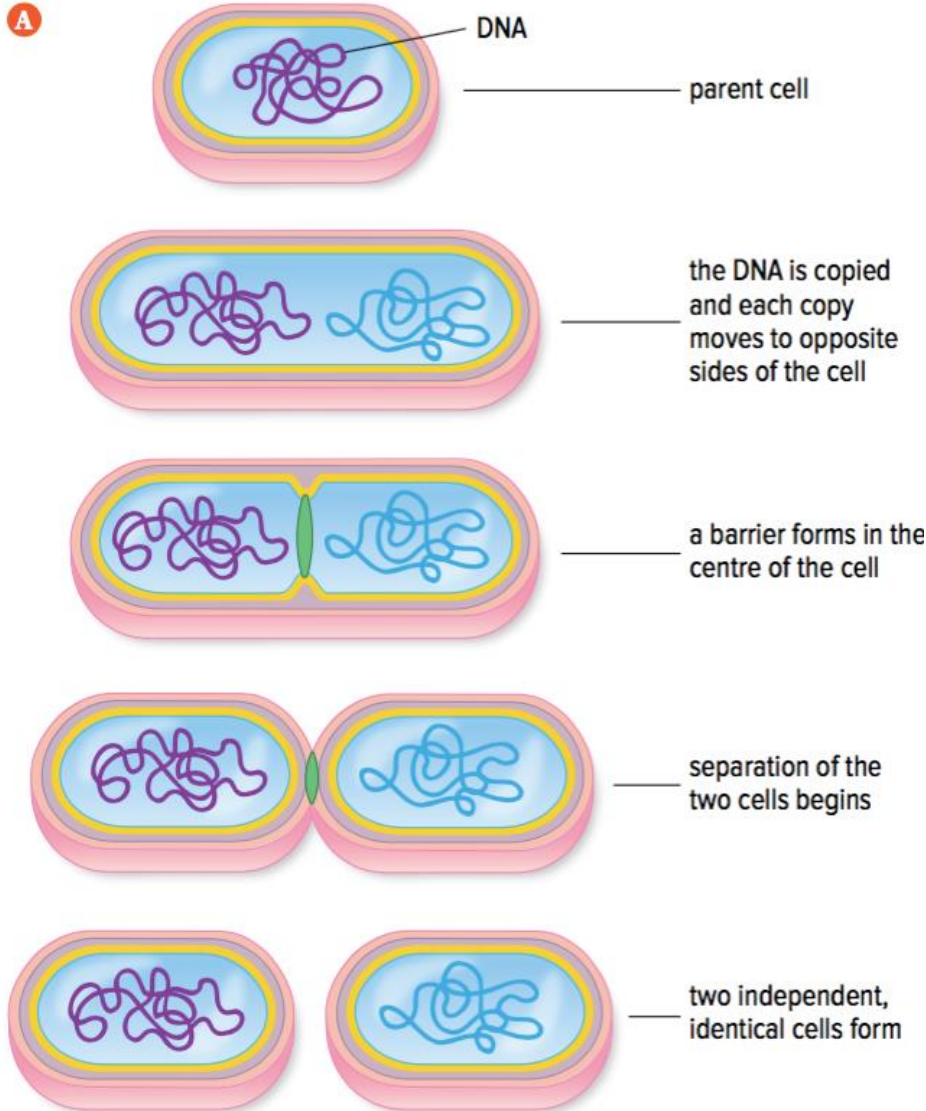
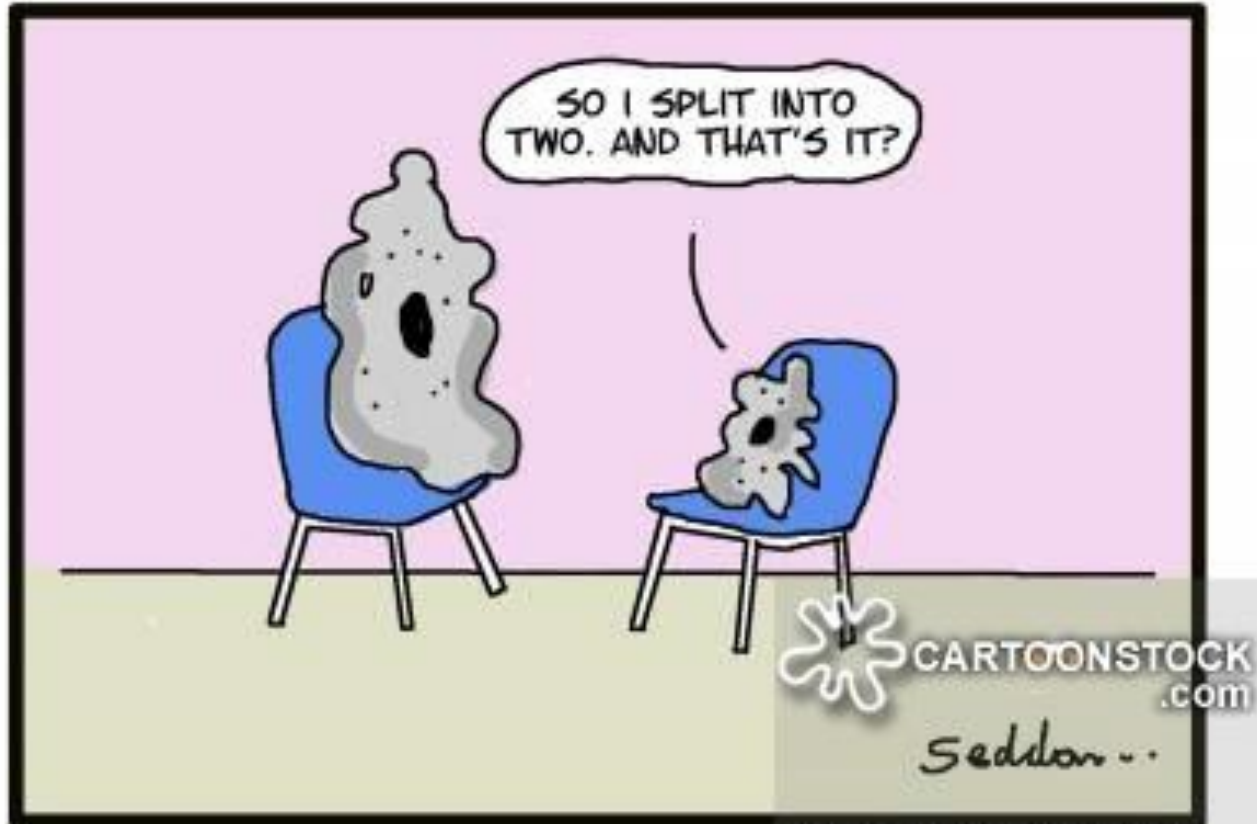


Figure 1.7: (A) Binary fission. (B) Many types of bacteria are found as chains and clusters.

Reproduction by Binary Fission (continued)



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Harry has the little talk
about the birds and the bees.

Discussion Questions

1. What key piece of evidence tells you that bacteria reproduce asexually?

Concept 3: Yeasts reproduce by budding.

Yeasts are unicellular eukaryotic micro-organisms

- Commonly used to make dough, bread, pretzels, soy sauce, cheese, vinegar
- Reproduce by asexual reproduction: **budding**



Figure 1.11: Yeast

Asexual Reproduction in Yeast: Budding

Budding:

- Yeast cell grows a bud that pinches off to become a separate cell
- New cell is smaller than original cell at first
 - Eventually grows to the same size as other yeast cells

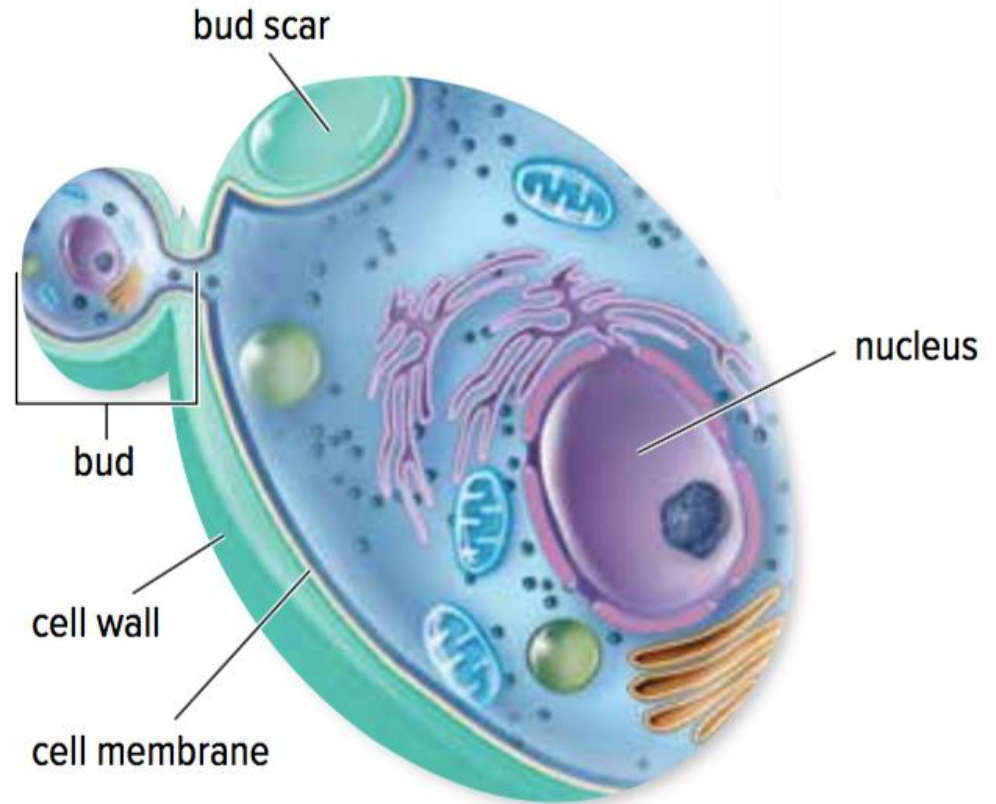


Figure 1.11: Yeasts reproduce asexually by budding.

Discussion Questions

1. In what ways is reproduction in yeasts and bacteria similar? In what ways is it different?
2. Why is a daughter yeast cell identical to the parent cell?

Concept 4: Moulds reproduce using spores.

Moulds are composed of many eukaryotic cells

- Reproduce by asexual reproduction using **spores**

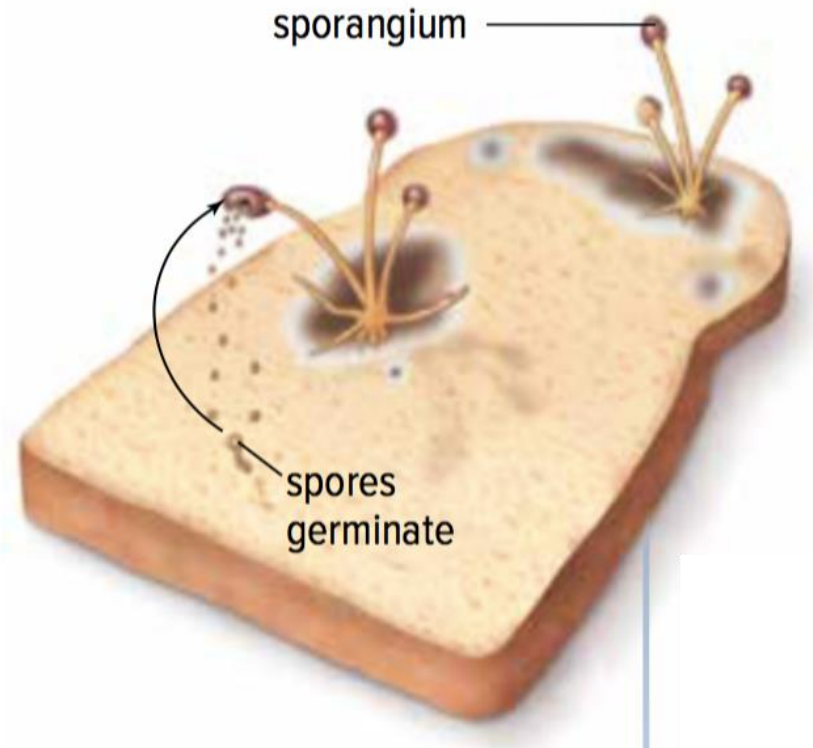


Figure 1.12: Moulds reproduce using spores.

Asexual Reproduction in Moulds: Spores

- Spores are released into the air from a specialized structure
- When a spore lands in a favourable environment (warm, moist), it grows and divides by mitosis and cytokinesis

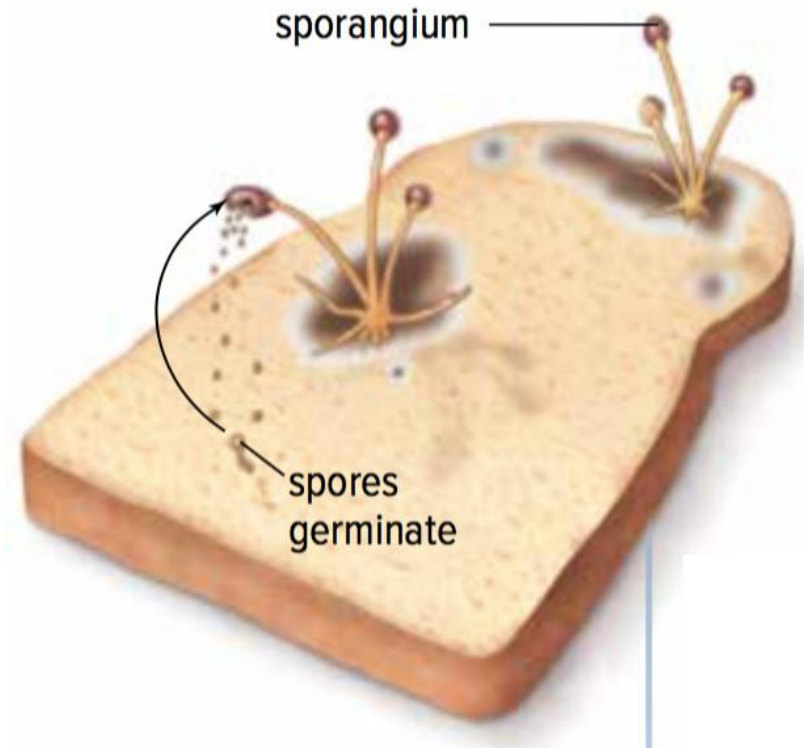


Figure 1.12: Moulds reproduce using spores.

Discussion Questions

1. What role do spores play in the asexual reproduction of moulds?

Concept 5: Plants have many ways to reproduce asexually.

Plants reproduce sexually and asexually

- Asexual reproduction: **Vegetative propagation**
 - New plants grow from a portion of the roots, stems, or leaves from an existing plant
 - New plants are **clones** (copies) of the parent plant

Vegetative Propagation: Example

Potatoes:

- New roots and shoots grow from the eyes of a potato
- If you plant a potato with this new growth, a potato plant will develop
- The new plant will be identical to the parent plant



Figure 1.13

Vegetative Propagation: Example

Runners are horizontal stems that give rise to new plants

- E.g. strawberries, buttercup, clover

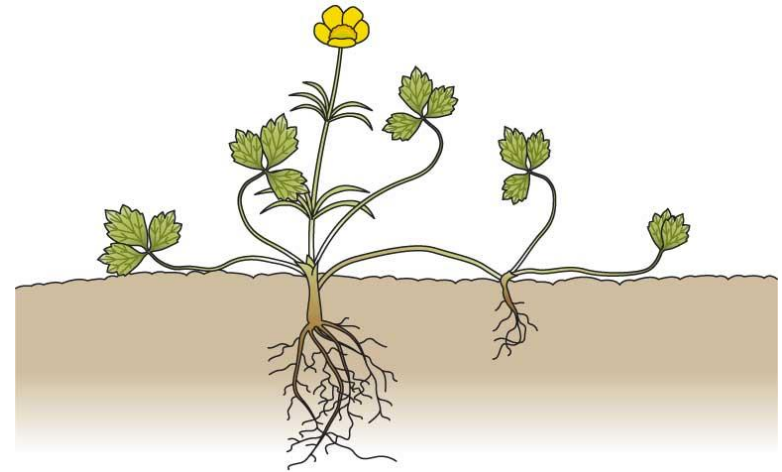


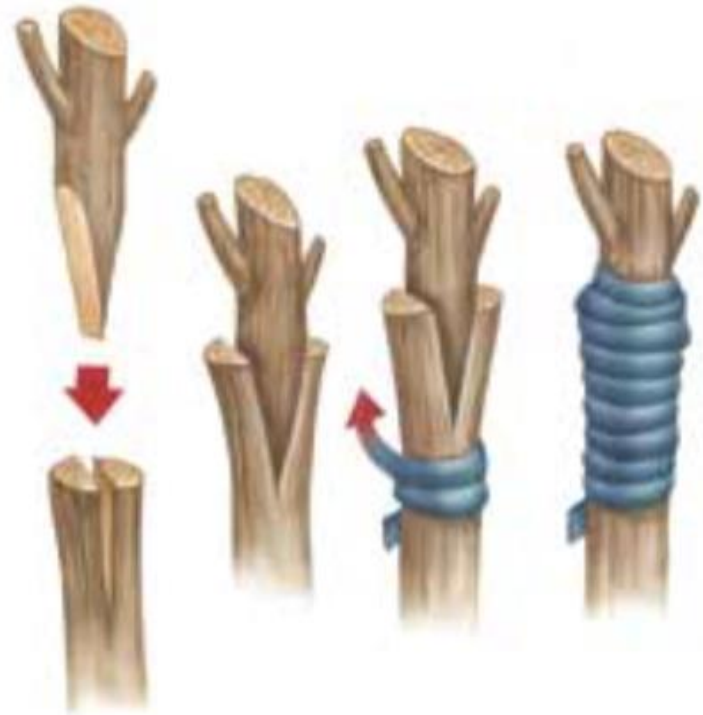
Figure 1.13: If you look closely at a field of strawberry plants, you will see smaller plants growing near a larger plant. These smaller plants are new plants that grow along runners. Runners are like stems that grow horizontally, above the ground, from a full-grown plant. Eventually runners die, leaving independent, identical plants.

Artificial Vegetative Propagation

Artificial vegetative propagation uses techniques to produce plants with specific characteristics

Example: **Grafting**

- A bud, stem, or root is cut from one plant and joined to another
- Used to produce trees with high-quality fruit or resistance to disease





© Mike Walker

Discussion Questions

1. Describe an example of vegetative propagation.
2. Why are new strawberry plants that form from runners identical to the parent plant?

Topic 1.2 Summary: What are different ways that living things reproduce asexually?

- Bacteria reproduce by binary fission.
- All eukaryotic cells reproduce by the cell cycle.
- Yeasts reproduce by budding.
- Moulds reproduce using spores.
- Plants have many ways to reproduce asexually.

