McGraw-Hill Ryerson

BC Science Connections 9

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 1: Bacteria reproduce by binary fission.

Bacteria: Micro-organisms that exist as single prokaryotic cells

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

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)

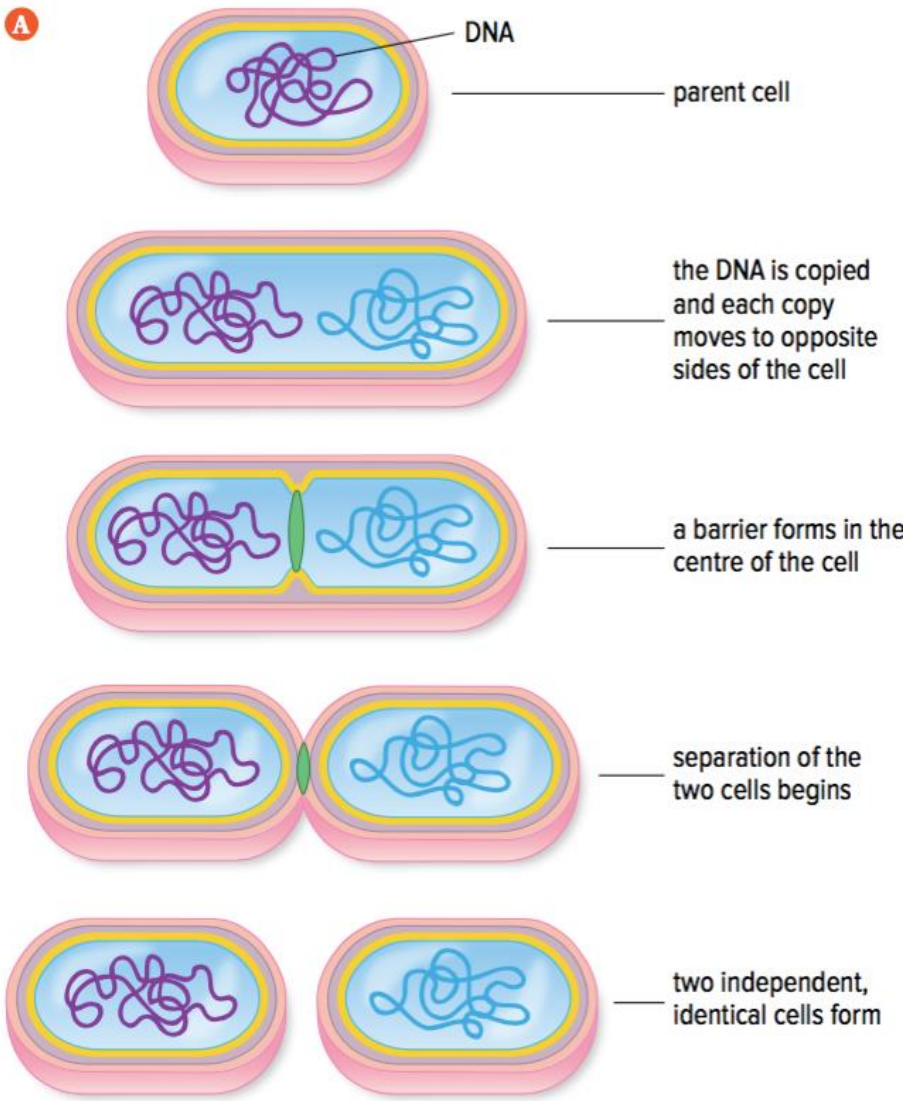
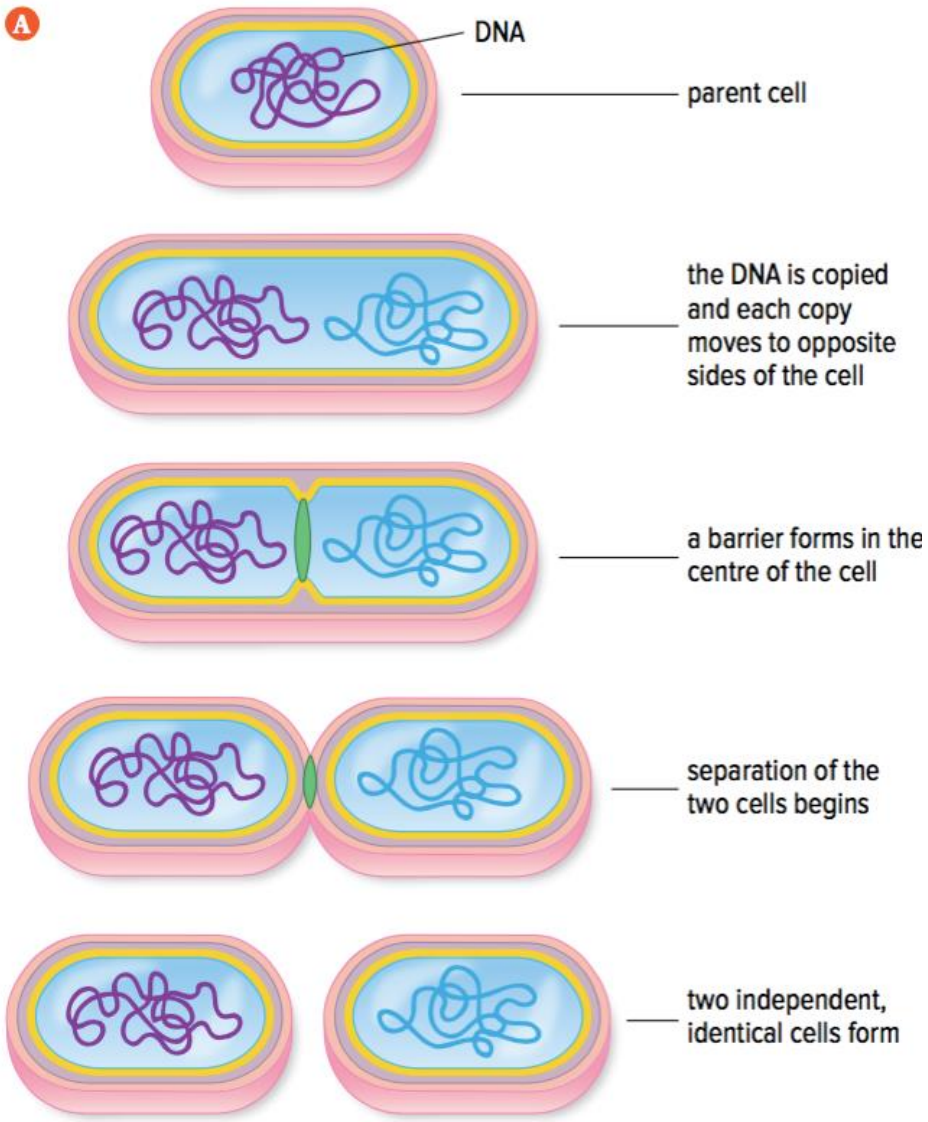


Figure 1.7: Binary fission

Reproduction by Binary Fission (continued)



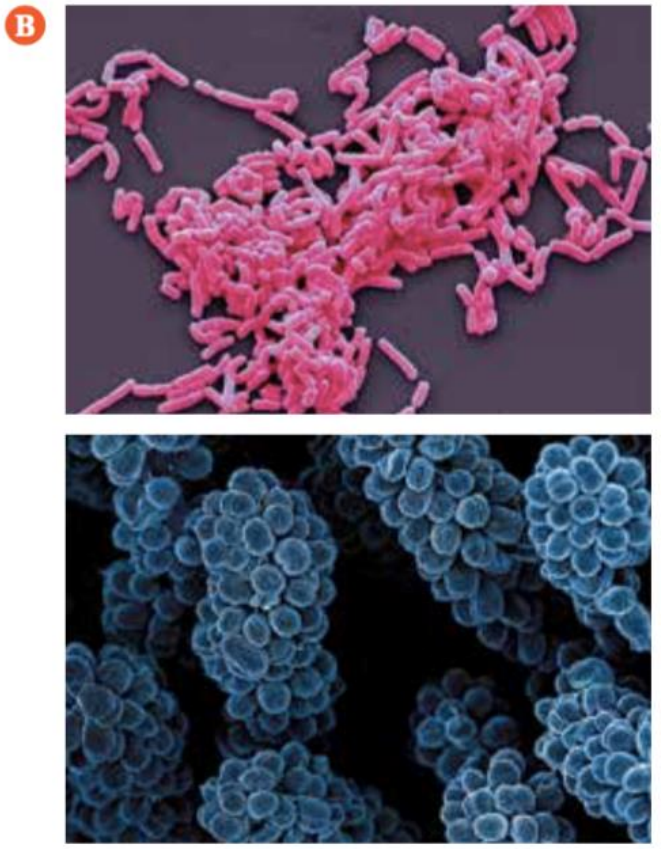


Figure 1.7: (A) Binary fission. (B) Many types of bacteria are found as chains and clusters.

Reproduction by Binary Fission (continued)

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 2: All eukaryotic cells reproduce by the cell cycle.

Functions of eukaryotic cell reproduction:

- 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

Eukaryotic cells reproduce by a series of events called the **cell cycle**

The cell cycle has two stages with different events:

- **Growth and development**
  - Interphase (replication of DNA
- **Cell division**
  - Mitosis (division of nucleus)
  - Cytokinesis (division of cytoplasm and cell membrane)

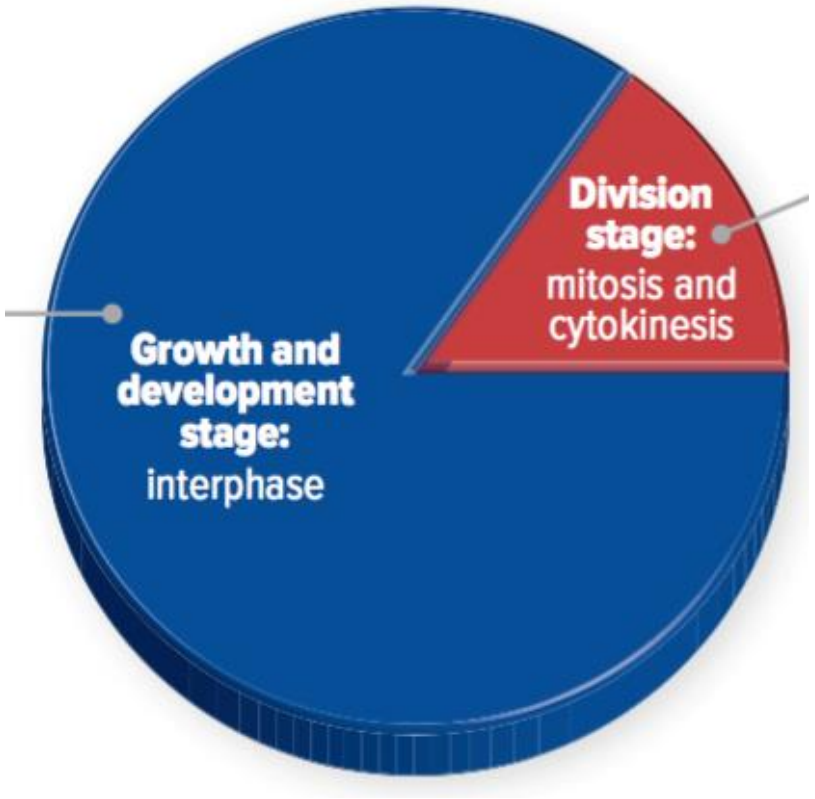
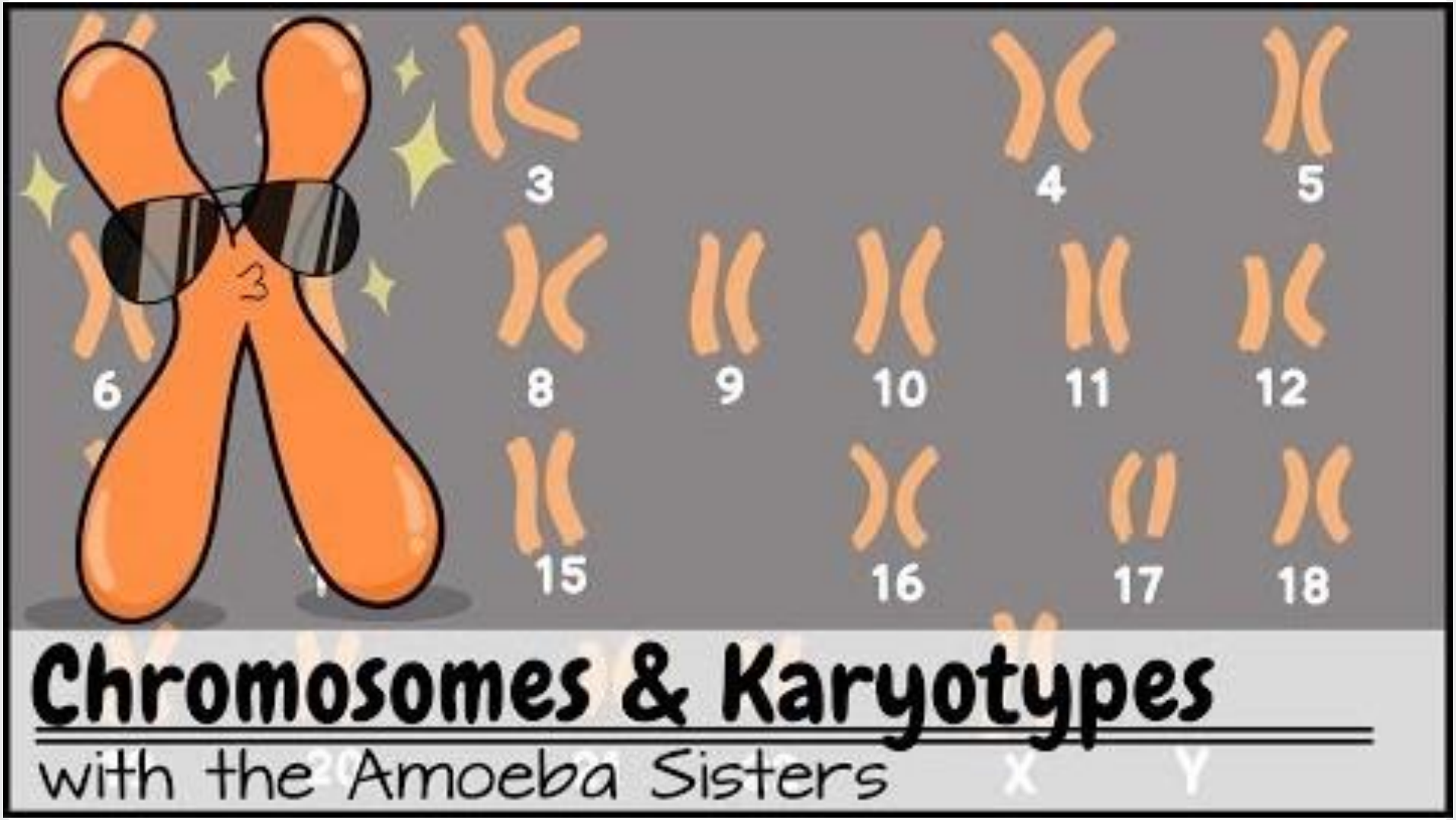


Figure 1.10: The cell cycle.

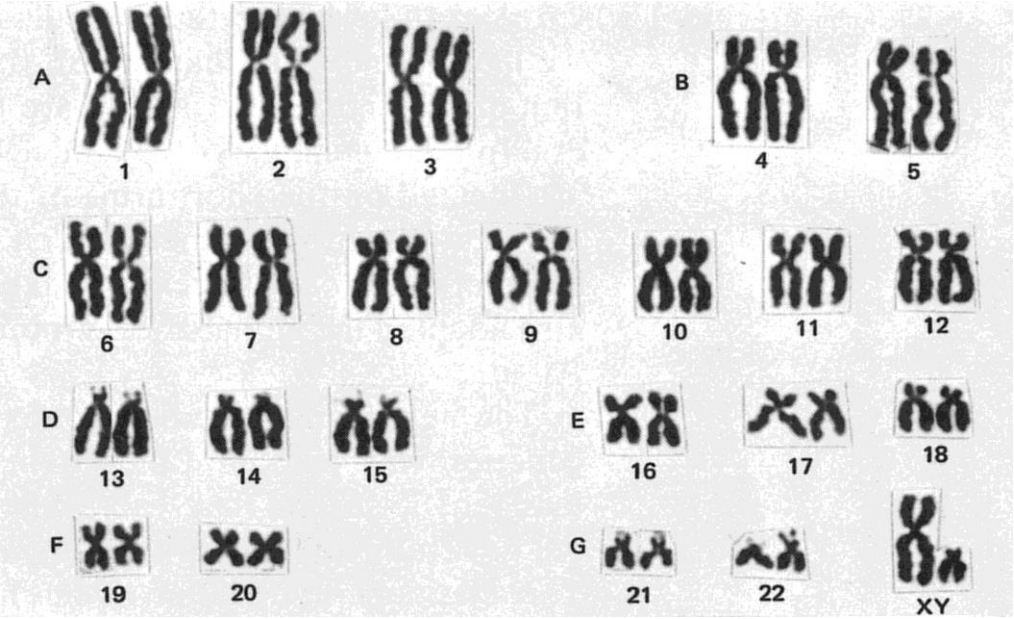


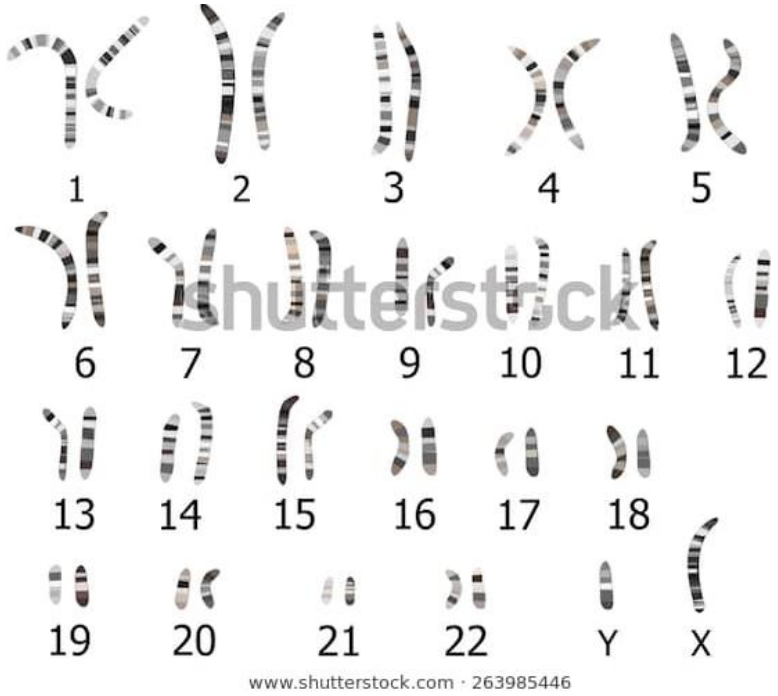
https://www.youtube.com/watch?v=mBq1ULWJp_M&t=208s&ab_channel=AmoebaSisters 1:15-3:11

Chromosomes Elaborations (not in textbook)

The karyotype is a complete picture of an individual's chromosomes.

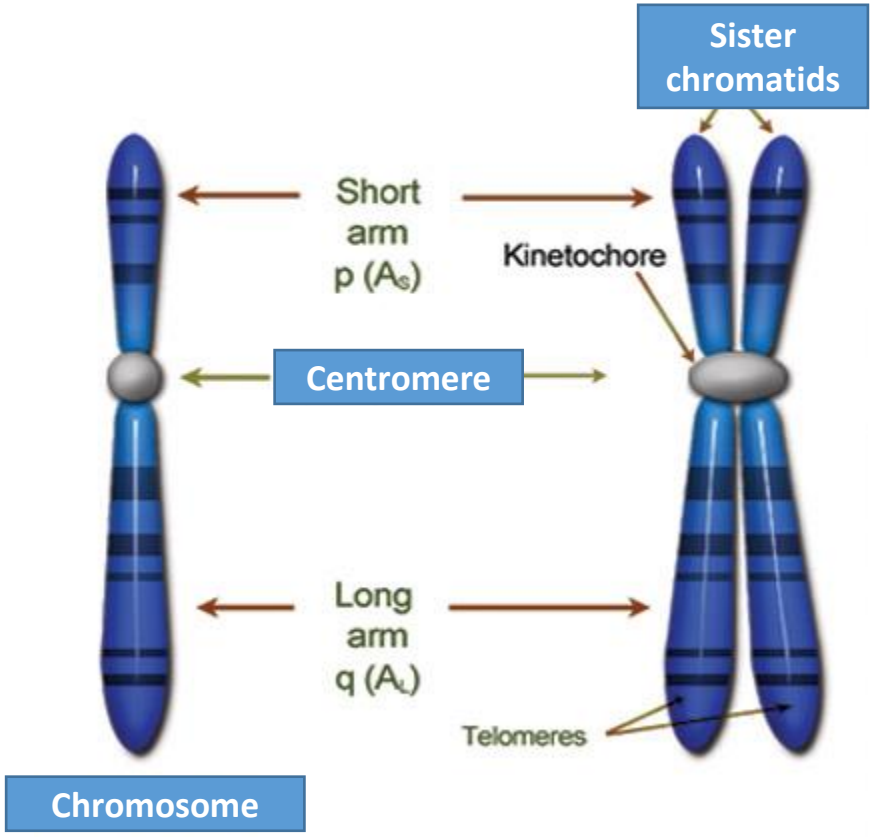
These images are *both* human karyotypes. What do you notice?



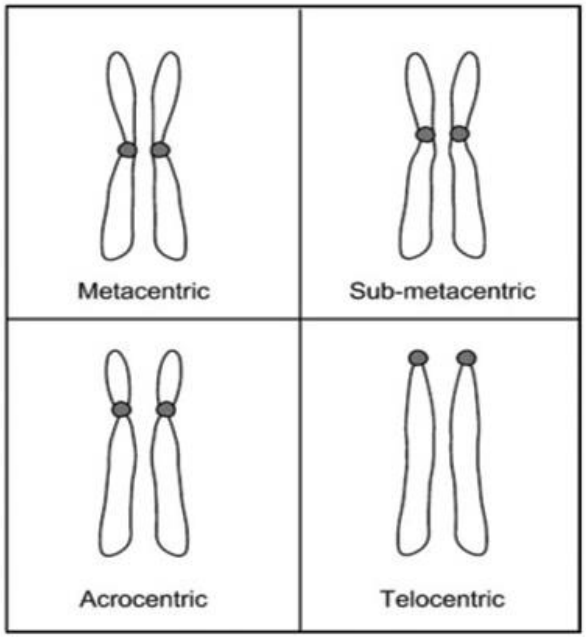


https://www.mun.ca/biology/scarr/Human_Karyotype.html
https://www.shutterstock.com/image-illustration/human-karyotype-illustration-263985446

Chromosomes Elaborations (not in textbook)



- Chromosomes come in different shapes and sizes.
- *Each chromosome has one **centromere**.*

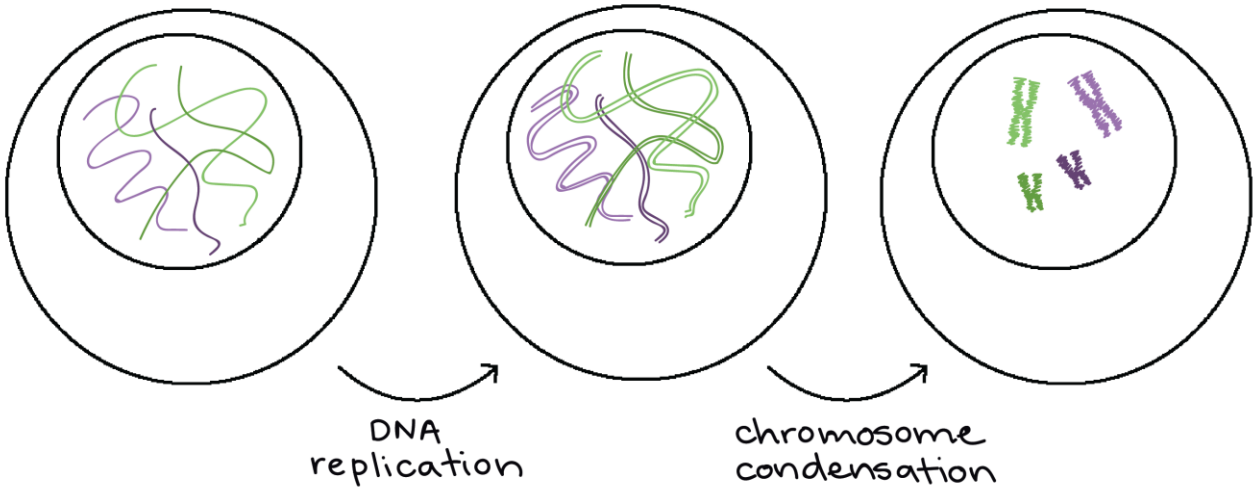


https://microbenotes.com/chromosome-structure-types-and-functions/

(For this slide, ignore all vocab except what is highlighted in blue.)

Chromosomes Elaborations (not in textbook)

DNA is replicated during interphase.



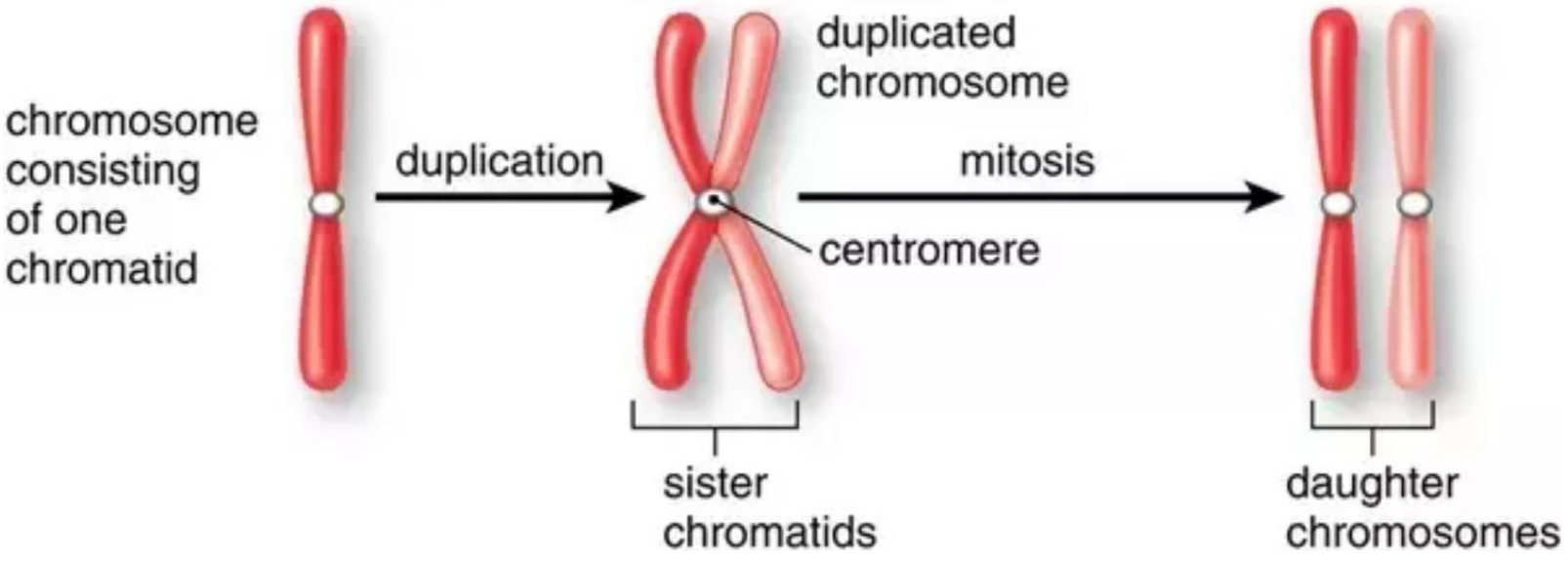
https://www.khanacademy.org/science/high-school-biology/hs-reproduction-and-cell-division/hs-chromosome-structure-and-numbers/a/dna-and-chromosomes-article

Chromosomes Elaborations (not in textbook)

DNA is replicated during interphase.

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

- Before replication, each chromosome is one chromatid.
- After replication, each chromosome is made of two **sister chromatids** connected by a single centromere.



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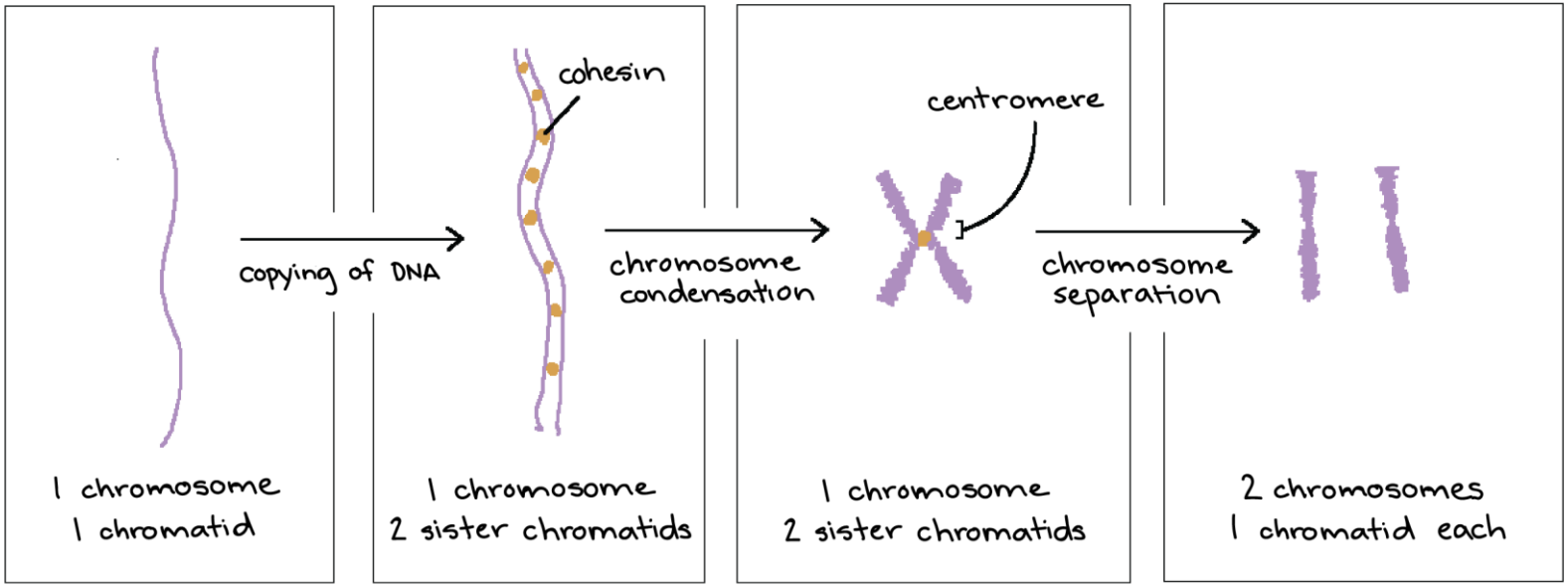
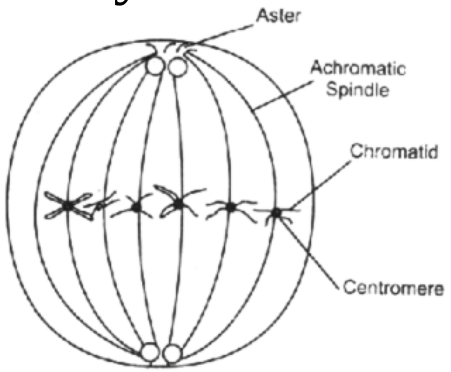
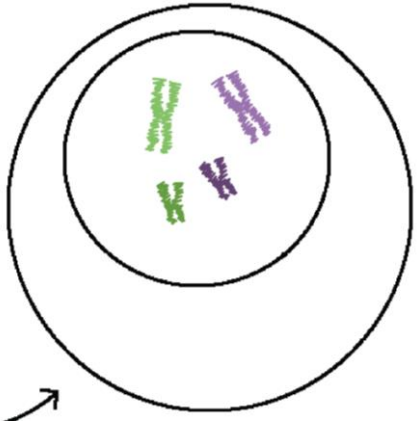


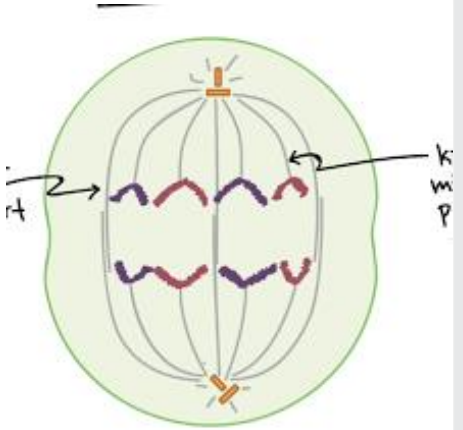
https://www.khanacademy.org/science/high-school-biology/hs-reproduction-and-cell-division/hs-chromosome-structure-and-numbers/a/dna-and-chromosomes-article

Practice: Chromosomes

1. How many chromosomes?







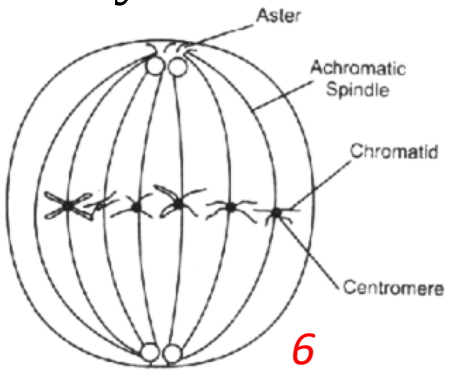
2. Draw a non-replicated chromosome.

3. Draw a replicated chromosome. When does replication take place?

https://microbenotes.com/chromosome-structure-types-and-functions/

Practice: Chromosomes

1. How many chromosomes?



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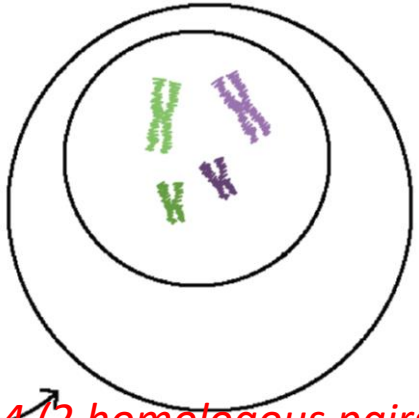
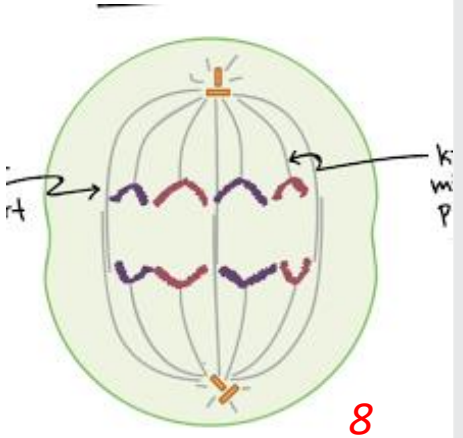


4 (2 homologous pairs)



8

2. Draw a non-replicated chromosome.

3. Draw a replicated chromosome. When does replication take place?

During interphase (before mitosis)

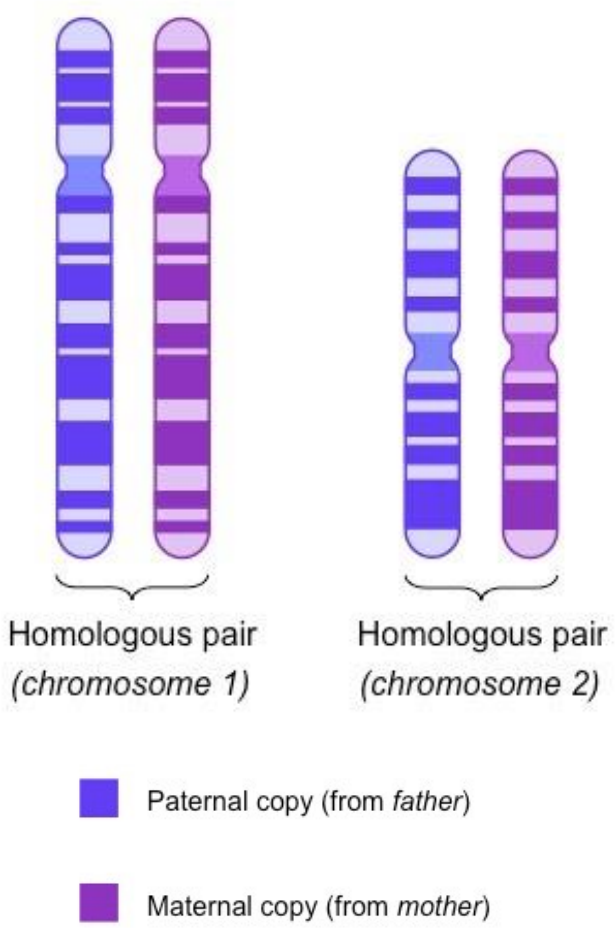
https://microbenotes.com/chromosome-structure-types-and-functions/

Chromosomes Elaborations (not in textbook)

In organisms that reproduce sexually, one set of chromosomes is inherited from each parent.

Homologous chromosomes:

- Pair of chromosomes (one from each parent) that are similar in length, centromere location, and the locations of genes on them. They may differ in the exact versions of the genes they carry.



https://ib.bioninja.com.au/standard-level/topic-3-genetics/32-chromosomes/homologous-pairs.html

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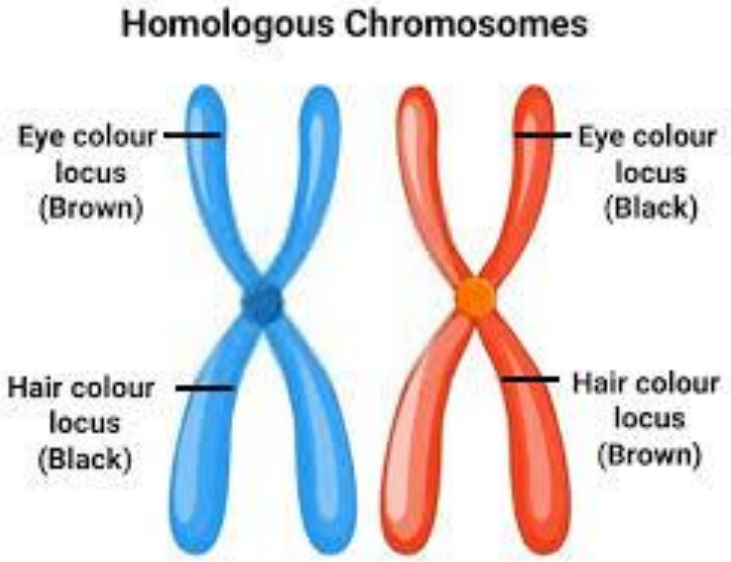


https://www.toppr.com/content/story/amp/chromosomes-397/

Practice: Chromosomes

4. Draw homologous chromosomes using the diagrams below as guides. Label chromatids, sister chromatids, and centromeres.

a) 

b) 

5. What is wrong with this picture?

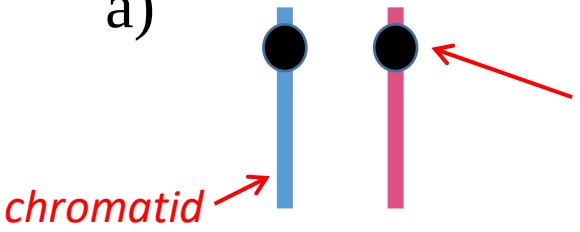
6. Sister chromatids and homologous chromosomes are often confused. How will you remember the difference?

https://microbenotes.com/chromosome-structure-types-and-functions/

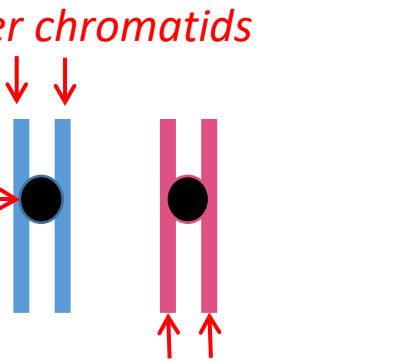
Practice: Chromosomes

4. Draw homologous chromosomes using the diagrams below as guides. Label chromatids, sister chromatids, and centromeres.

a)



b)



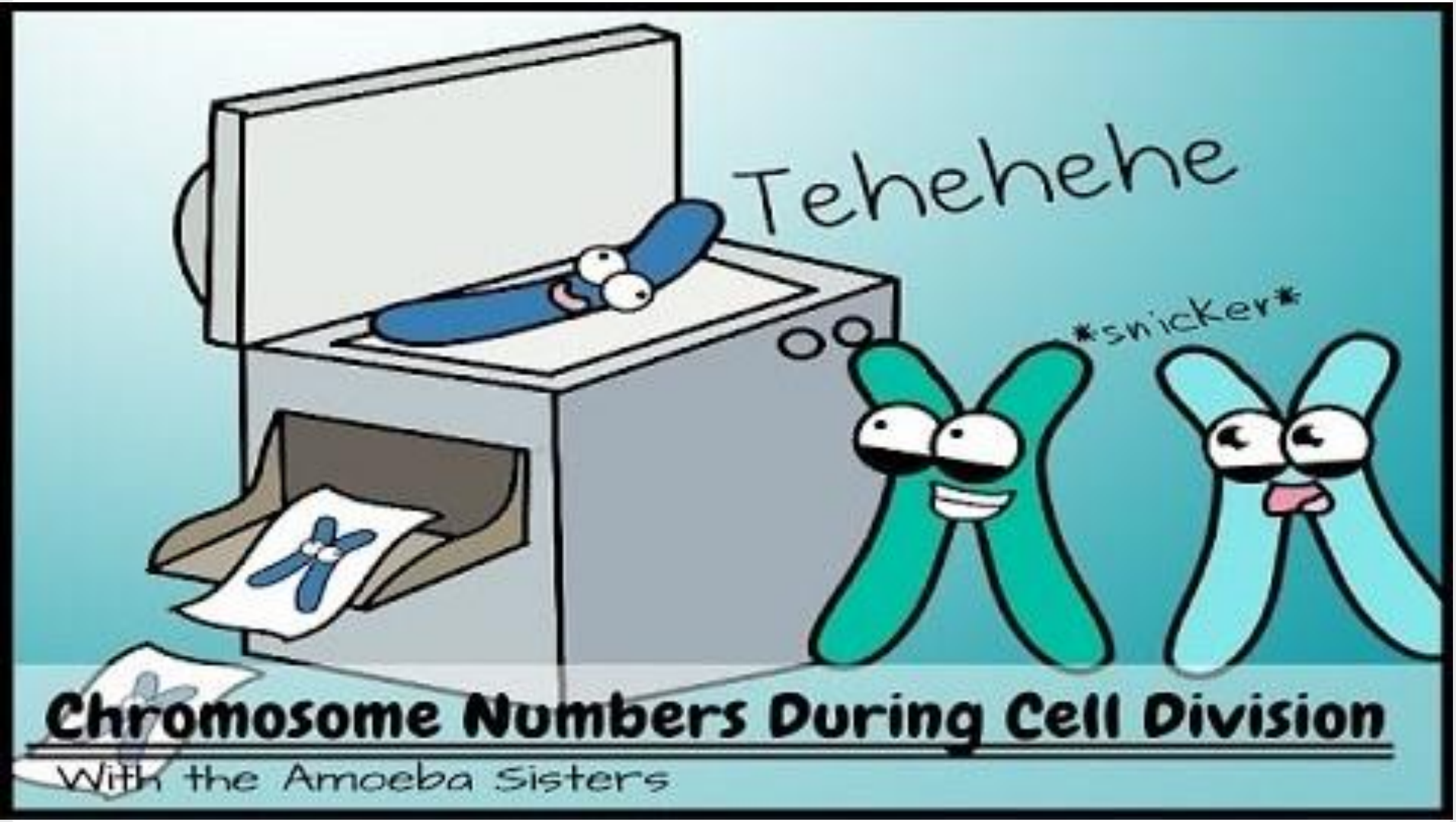
5. What is wrong with this picture?

In a replicated chromosome, the two copies need to be identical sister chromatids. This picture uses different colours for the copies, suggesting that they are homologous, which makes no sense. If they are connected with a centromere, they must have the same DNA sequence…same colour, same length, same genes.

6. Sister chromatids and homologous chromosomes are often confused. How will you remember the difference?

Answers will vary.
Homologous chromosomes are a pair of chromosomes (two centromeres). They are very similar but their DNA sequences are not identical. They contain important differences that affect biodiversity (e.g. why your siblings look different).
They make up a single replicated chromosome (one centromere). Sister chromatids have identical DNA sequences. During mitosis, sister chromatids split and form two identical chromosomes…one for each of the identical daughter cells.

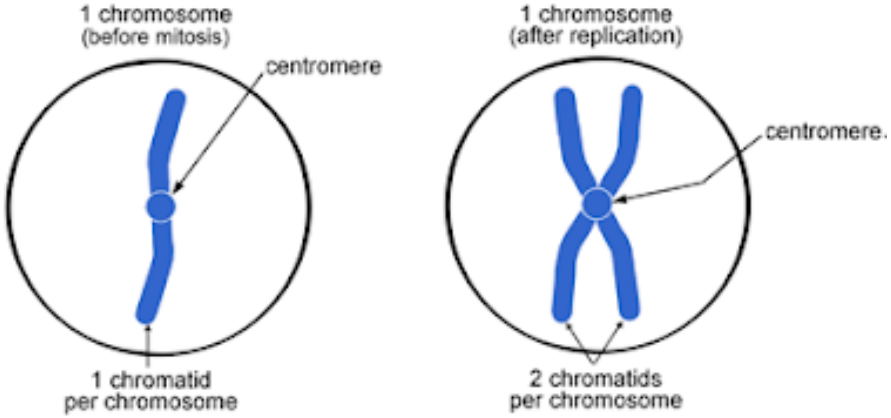
https://microbenotes.com/chromosome-structure-types-and-functions/

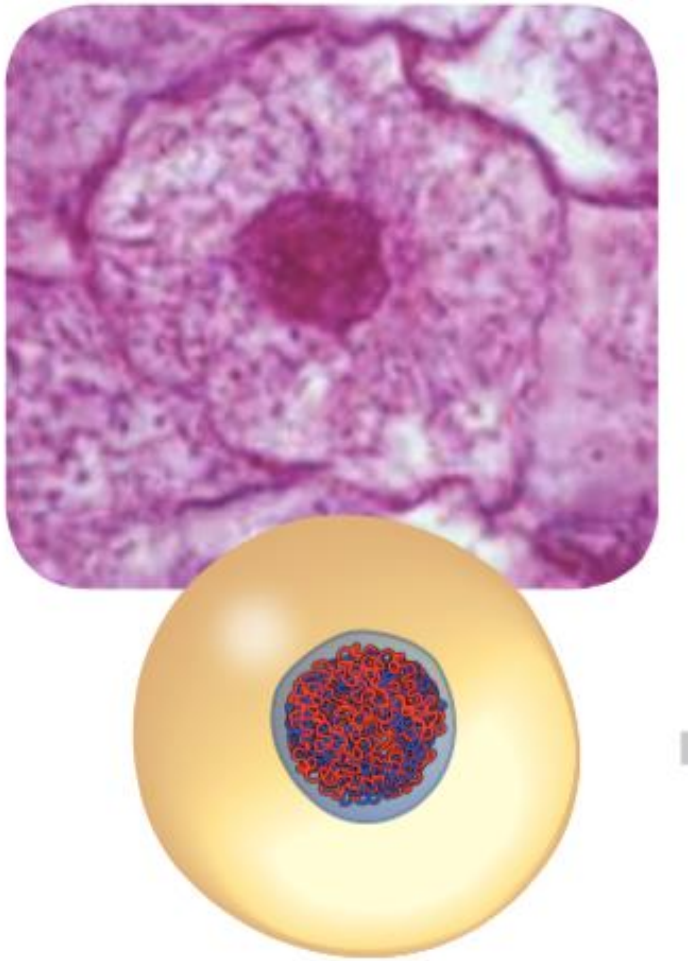


https://www.youtube.com/watch?v=gcz1FOWw0Cg&ab_channel=AmoebaSisters

Growth and Development: Interphase

- The cell grows and the number of organelles increases
- DNA in the nucleus is copied



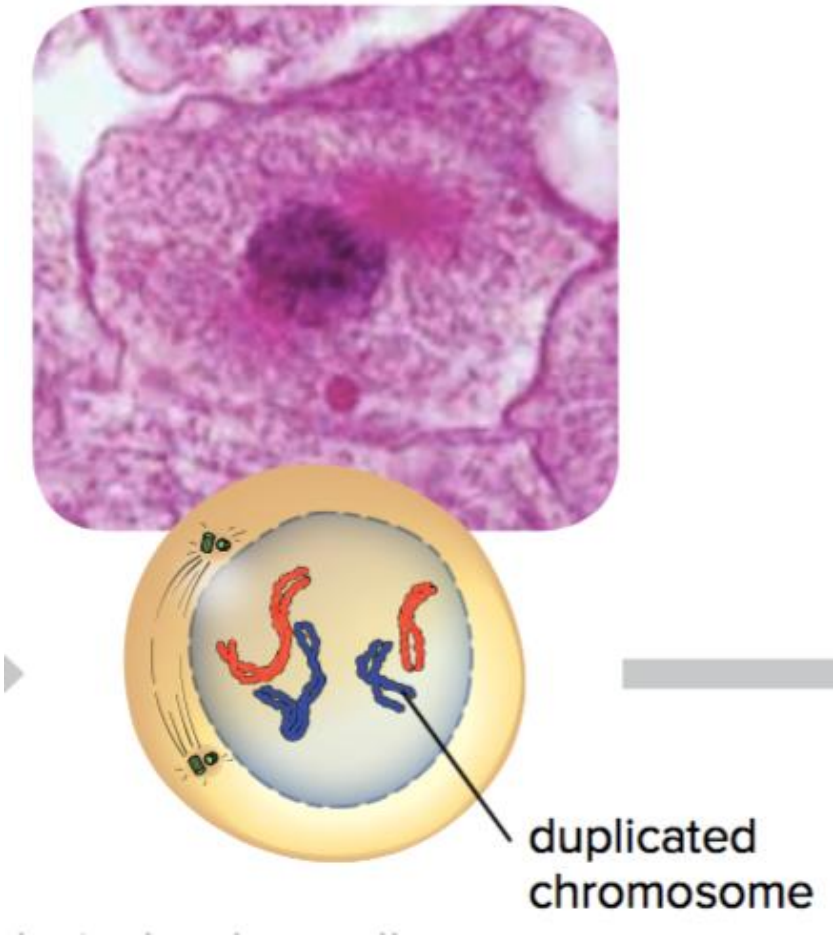


Cell Division: Phase 1 of Mitosis (Prophase)

- Nuclear membrane begins to disappear
- DNA condenses into duplicated chromosomes
  - Each chromosome contains two copies of the same DNA (the copies were made in interphase)

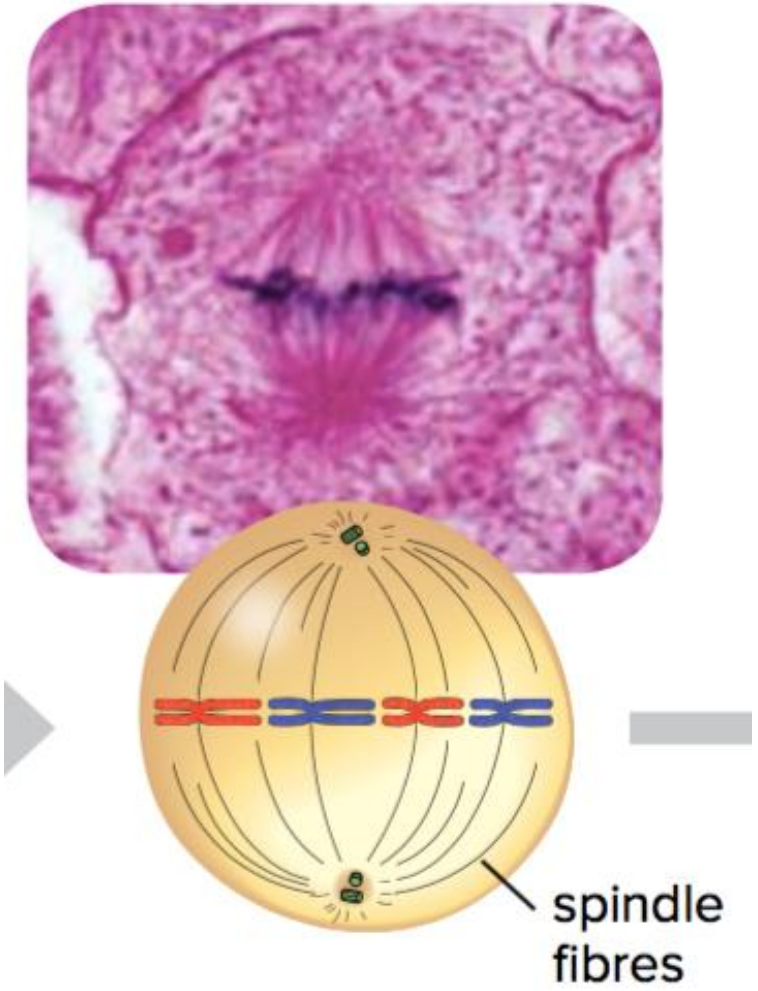
Note about diagram:
Red chromosomes from mom; blue chromosomes from dad

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



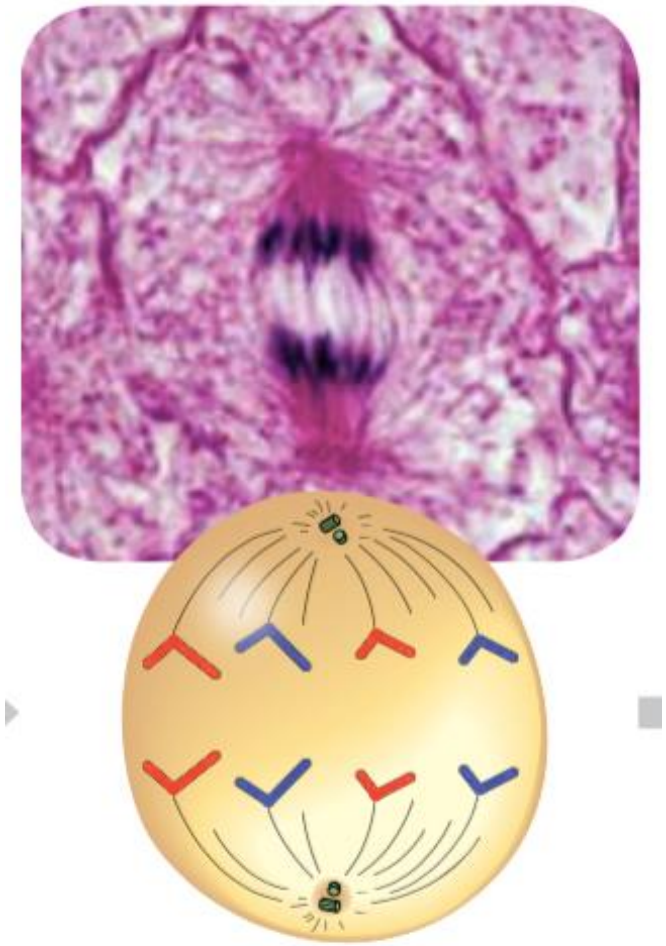
Cell Division: Phase 2 of Mitosis (Metaphase)

- Structures called spindle fibres guide chromosome movement
- Chromosomes line up along the middle of the cell



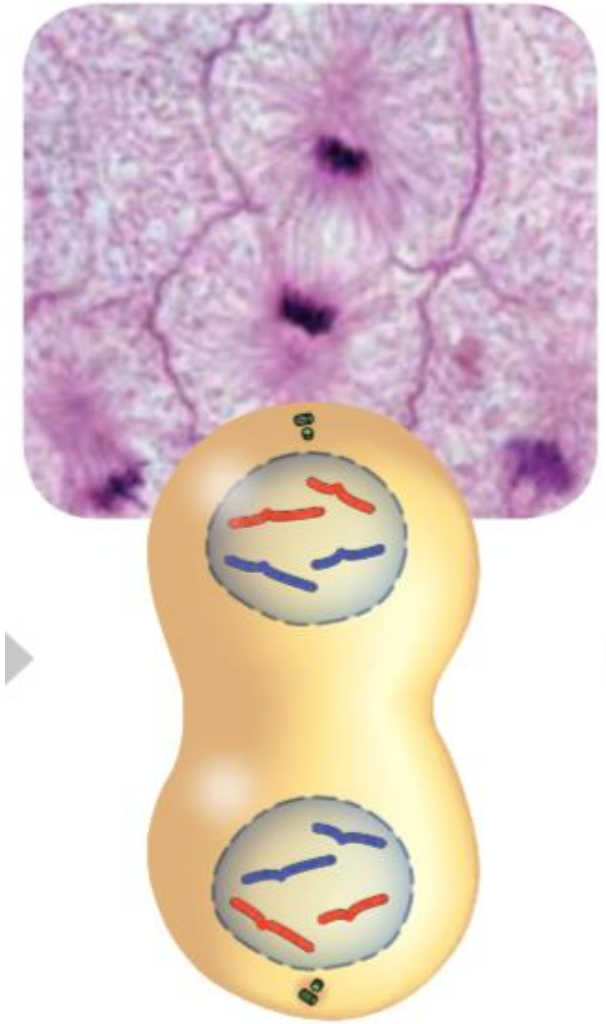
Cell Division: Phase 3 of Mitosis (Anaphase)

- Copies of DNA are separated and go to each end of the cell



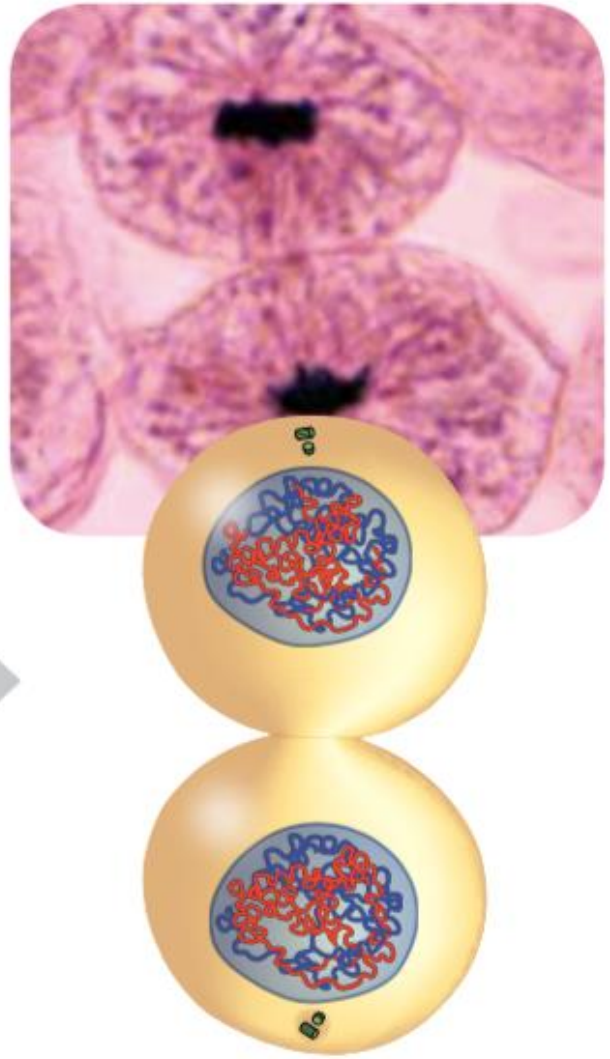
Cell Division: Phase 4 of Mitosis (Telophase)

- Two nuclei form
- Each nucleus contains a complete copy of the cell's DNA



Cell Division: Cytokinesis

- Cytoplasm and organelles are divided
- Two separate cells form
- The cells then begin interphase



Mitosis: Summary

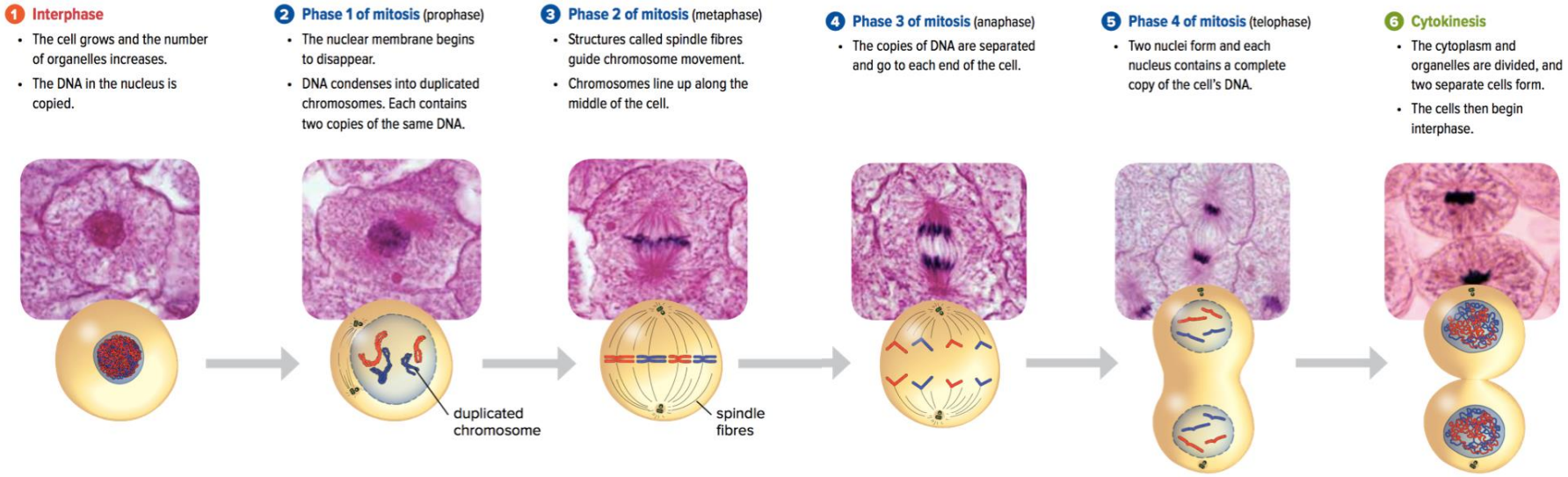
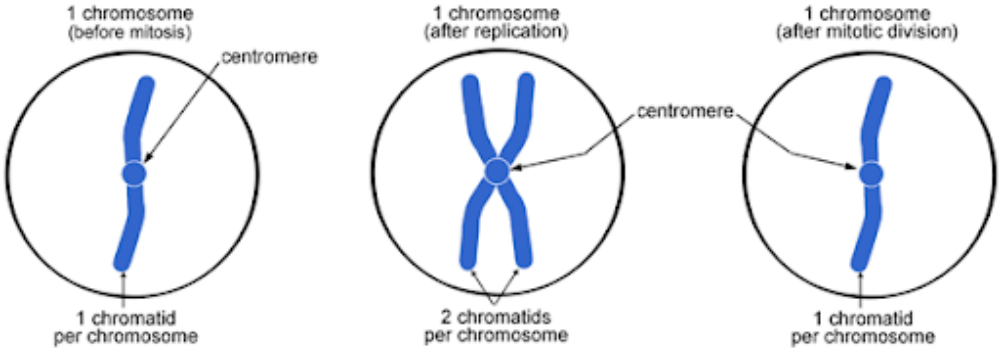


Figure 1.9: Cell reproduction by mitosis results in daughter cells that are genetically identical to each other and to the parent cell.



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

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 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

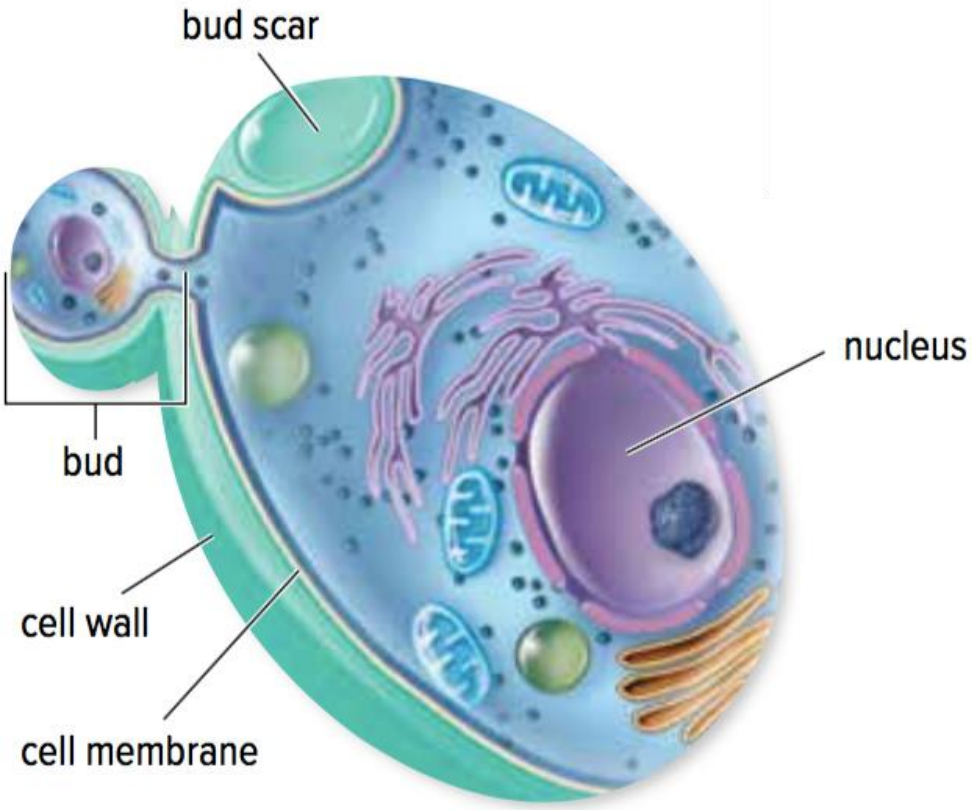


Figure 1.11: Yeasts reproduce asexually by budding.

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**

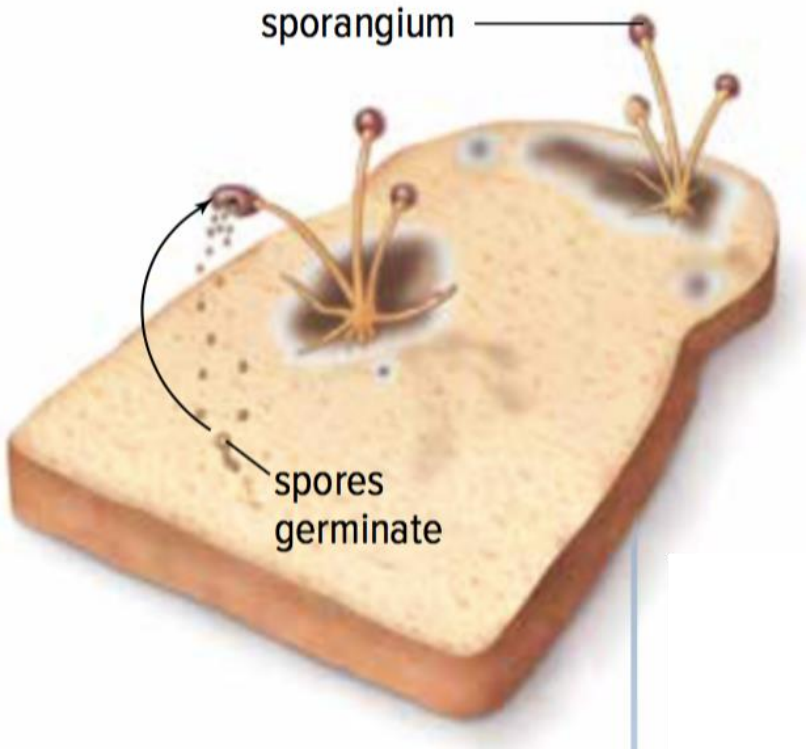


Figure 1.12: Moulds reproduce using spores.

Asexual Reproduction in Moulds: Spores

- Moulds form spores that are genetically identical to the mould cells they come from
  - Spores are released into the air from a structure called a *sporangium*
  - When a spore lands in a favourable environment (warm, moist), it grows and divides by mitosis and cytokinesis

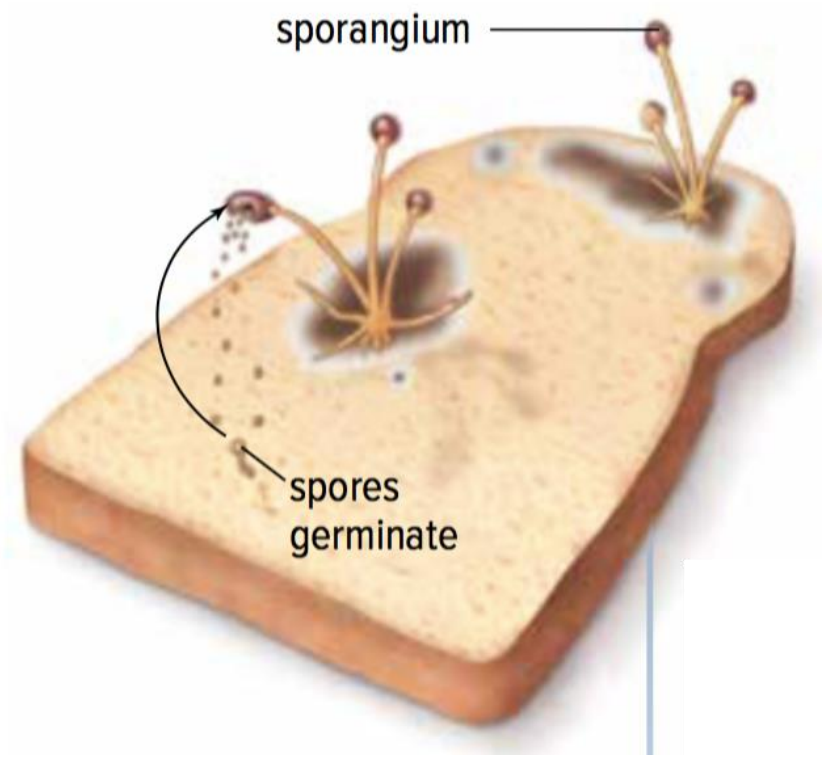


Figure 1.12: Moulds reproduce using spores.

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

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.

Vegetative Propagation: Example

Potatoes:

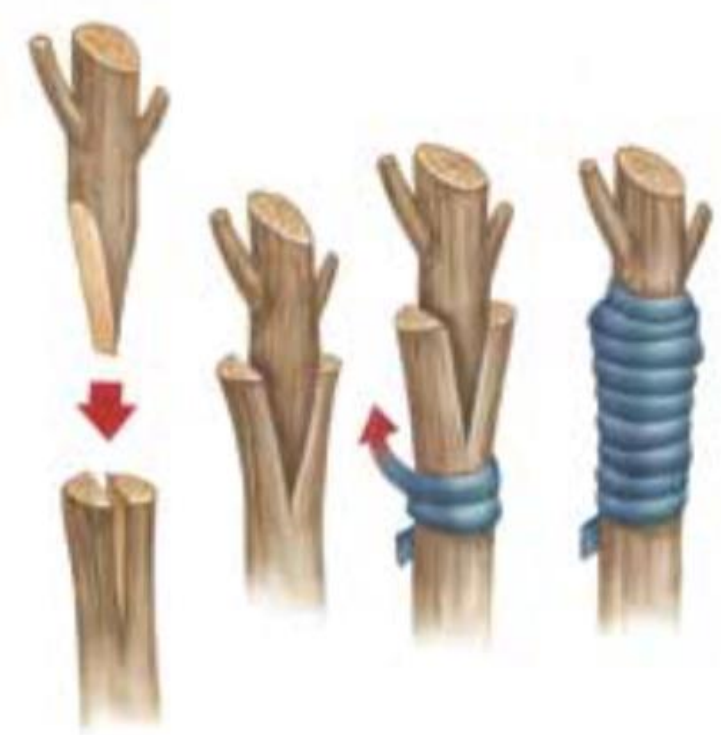
- New roots and shoots grow from the eyes of a potato
- If you plant a potato with this new growth, a potato plant will develop
- The new plant will be identical to the parent plant

Figure 1.13

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



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.