

Outcomes:

- Explain what binary fission is and the organisms which carry out binary fission.
- Describe the process of binary fission.
- Explain why viruses are not classified as being living organisms.
- Describe the sequence of events by which viruses replicate.
- Explain why viruses are so difficult to treat and develop medicines against.

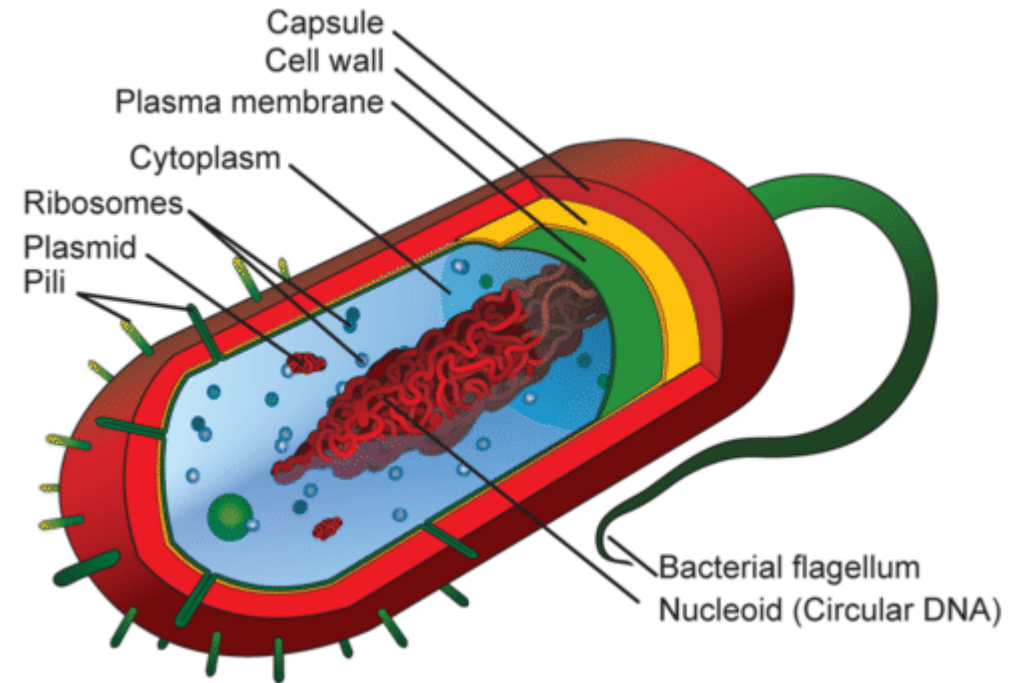
Explain what binary fission is and the organisms which carry out binary fission.

What is Binary fission?

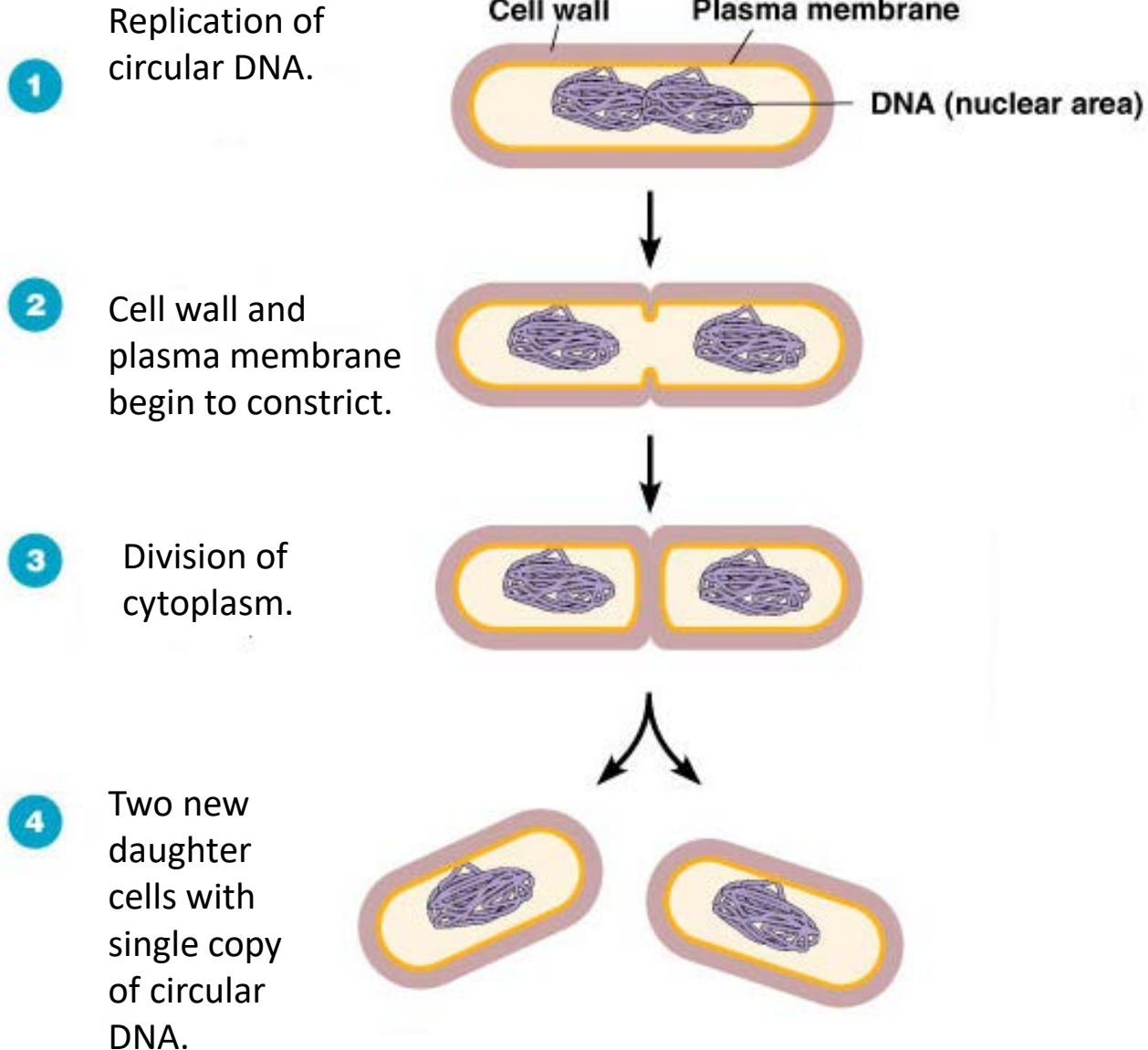
- Binary fission occurs in **prokaryotic cells**
- Where in this cell will DNA replication need to occur?

Circular DNA and plasmids

- **Plasmids can be found in variable amounts.**



Describe the process of binary fission.



Question:

1. A bacterial cell undergoes binary fission every twenty minutes. Starting with a single bacterium how many bacteria will be formed at the end of 3 hours?

3 Hours = 180 minutes

$180/20 = 9$ divisions take place

$2^9 = 512$ cells.

2. A bacterial cell undergoes binary fission every twenty minutes. Starting with a single bacterium how many bacteria will be formed at the end of 7 hours?

Give your answer in standard form.

7 hours = 420 minutes

$420/20 = 21$ divisions

$2^{21} = 2097152$

2.1×10^6 bacteria

Viruses are classed as non-living so do not undergo cell division.

You can be asked to describe the sequence of events by which viruses replicate.

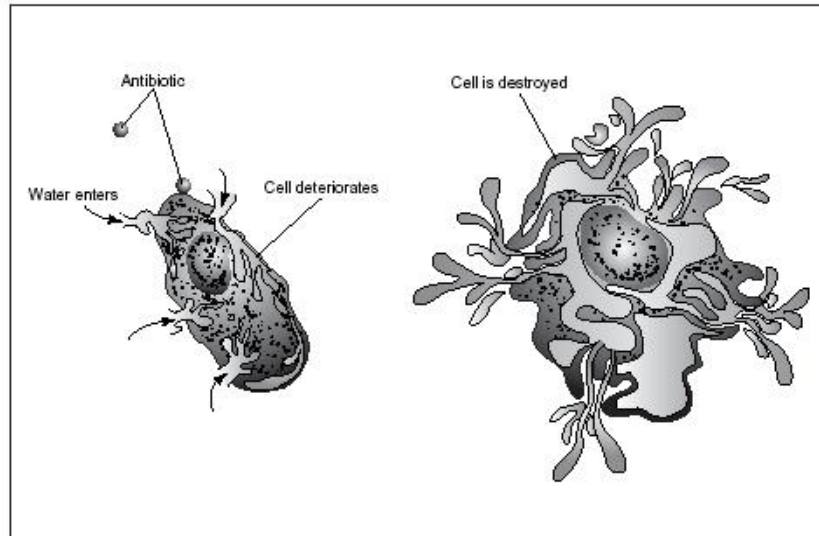
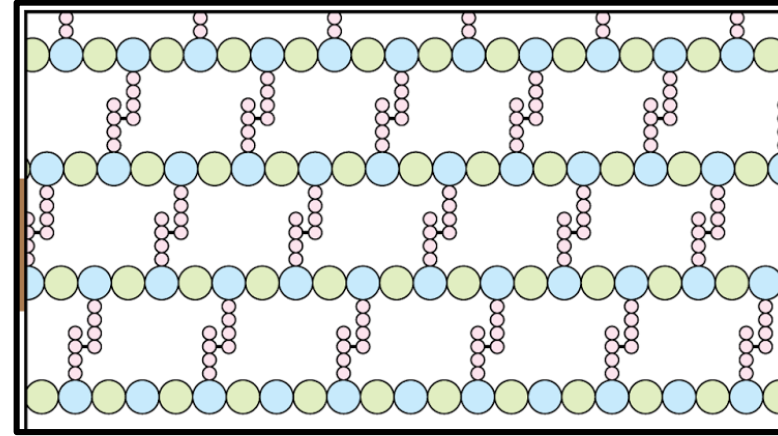
So you will need to make sure you recap this from the immunity topic.

And also...

Explain why viruses are so difficult to treat and develop medicines against which will be summarised on the next slide.

Viruses and antibiotics

- Antibiotics work by inhibiting enzymes that catalyse the formation of **murein** (peptidoglycan) cross linkages in bacterial cell walls.
- These cell walls prevent bacterial cells undergoing **osmotic lysis**
- Viruses **do not have cell walls** – therefore antibiotics are **ineffective**
- Also, once a virus has entered a body cell, antibiotics cannot reach it



Apply this knowledge to the exam questions on page 4-5.

The questions are worth 10 marks. Can you complete the exam question in 13 minutes?

Once you have completed the question, check your answers using the markscheme.

Remember

1. Highlight which part of your answer is also on the markscheme. Allow you to see which part of your answer are relevant.
2. If it isn't on the mark scheme it is not right, if it isn't written as the markscheme it is not right.
3. In a different coloured pen add corrections to the question.
4. Anything you don't understand make a note of for when you speak to your teacher.

Q1. (a) Bacteria are often used in industry as a source of enzymes. One reason is because bacteria divide rapidly, producing a large number of them in a short time.

Describe how bacteria divide.

Q1.

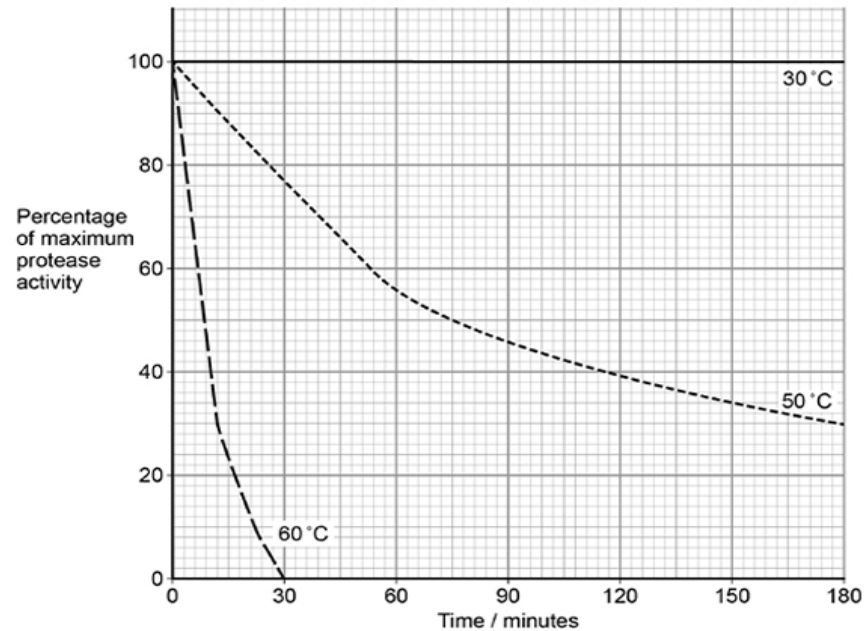
(a)

1. Binary fission;
2. Replication of (circular) DNA;
3. Division of cytoplasm to produce 2 daughter cells;
4. Each with single copy of (circular) DNA;

1. *Ignore reference to 'chromosome'*
2. *Ignore 'copy'.*
4. *Ignore references to number of plasmids.*

2 max

- (b) Washing powders often contain enzymes from bacteria. These enzymes include proteases that hydrolyse proteins in clothing stains.



The graph shows the effect of temperature on a protease that could be used in washing powder. Explain the shape of the curves at 50 °C and 60 °C.

- (b) 1. Both denatured (by high temperature);
2. Denaturation faster at 60 °C due to more (kinetic) energy;
3. Breaks hydrogen / ionic bonds (between amino acids / R groups);
4. Change in shape of the active site / active site no longer complementary **so** fewer enzyme-substrate complexes formed / substrate does not fit;
3. *Ignore references to disulphide bonds*
3. *Accept (at 60 °C) Change in shape of the active site / active site no longer complementary **so** no enzyme-substrate complexes formed / substrate does not fit;*

- (c) Some proteases are secreted as extracellular enzymes by bacteria. Suggest **one** advantage to a bacterium of secreting an extracellular protease in its natural environment. Explain your answer.
-

(c)

1. To digest protein;
2. (So) they can absorb amino acids for growth / reproduction / protein synthesis / synthesis of named cell component;

OR

(So) they can destroy a toxic substance / protein;

1. *For 'digest' accept 'break down' here.*
2. *Accept '(so) they can destroy antibodies / antibiotics / viral antigens / bacterial antigens'*

- (d) Mammals have some cells that produce extracellular proteases. They also have cells with membrane-bound dipeptidases. Describe the action of these membrane-bound dipeptidases and explain their importance.

(d)

1. Hydrolyse (peptide bonds) to release amino acids;
2. Amino acids can cross (cell) membrane;

OR

Dipeptides cannot cross (cell) membrane;

OR

Maintain concentration gradient of amino acids for absorption;

OR

Ensure (nearly) maximum yield from protein breakdown;

2. *Ignore references to crossing gut membranes.*
2. *Accept 'there are carrier proteins for amino acids'*
2. *Accept 'no carrier proteins for dipeptides'*

Outcomes:

- Explain outcome of mitosis.
- Explain the appearance of cells in each stage of mitosis.

Mitosis

Definition:

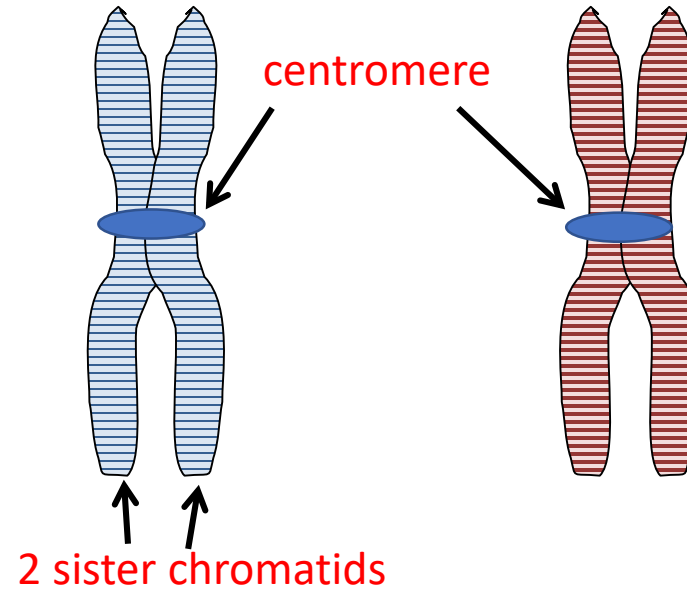
Production of two daughter cells that have the same number of chromosomes as the parent cell and each other.

What type of cells undergo mitosis?

Body cells

Interphase (not a true stage of mitosis!)

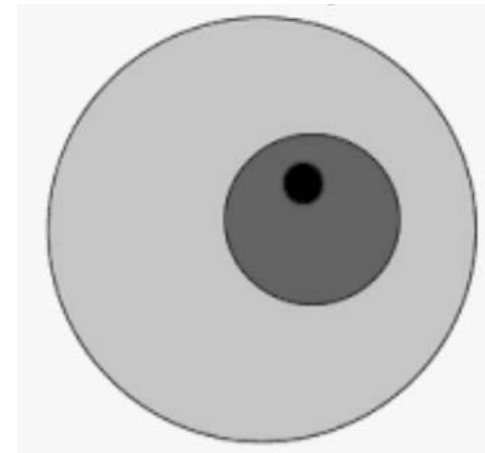
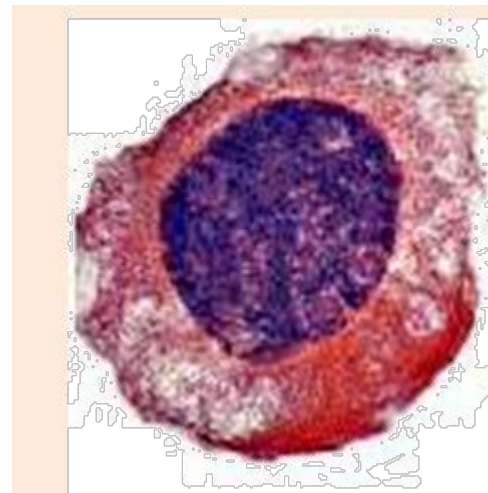
- Chromosomes are dispersed (so not visible)
- Each chromosome replicates.
- Chromosomes made of 2 sister chromatids, joined at centromere.



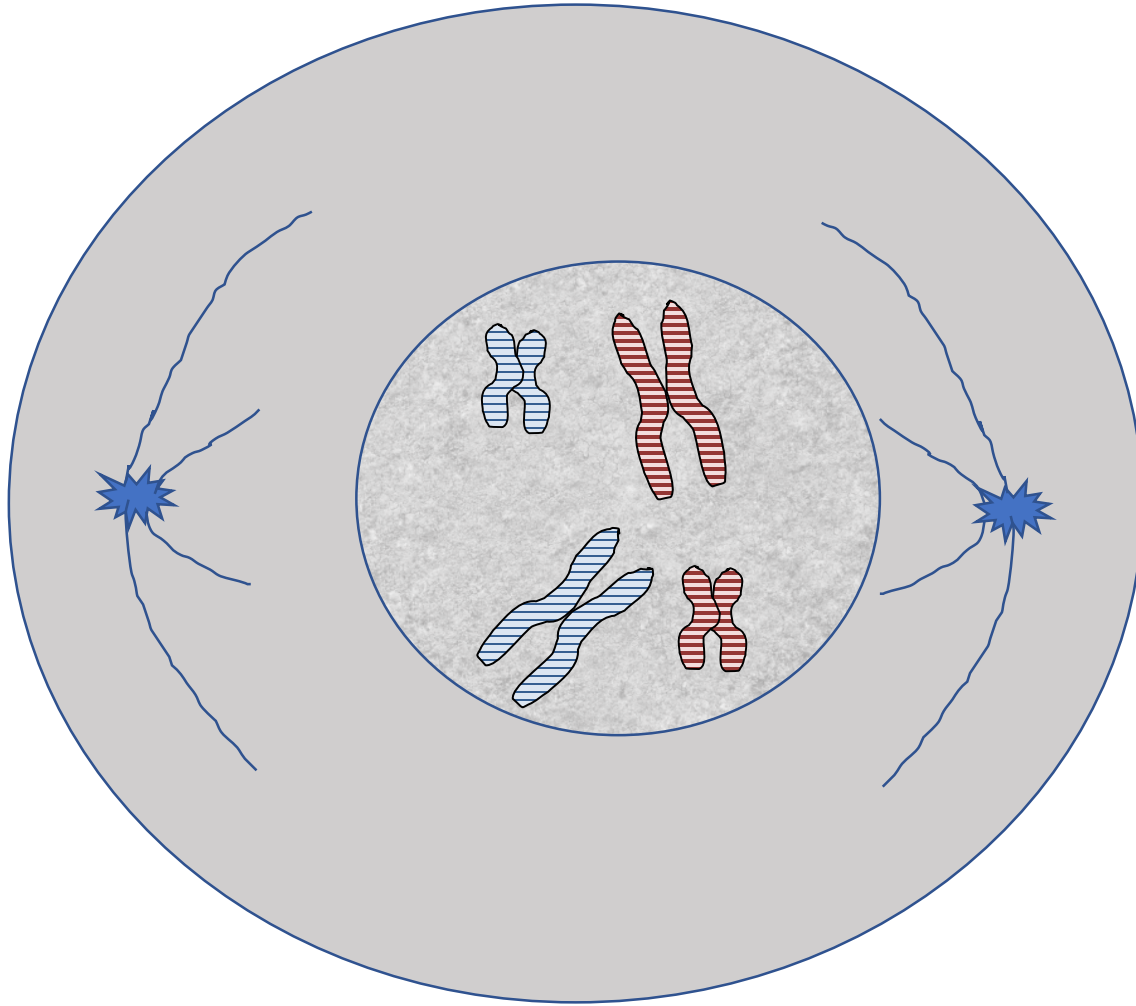
Homologous pair



Two chromosomes that carry the same genes

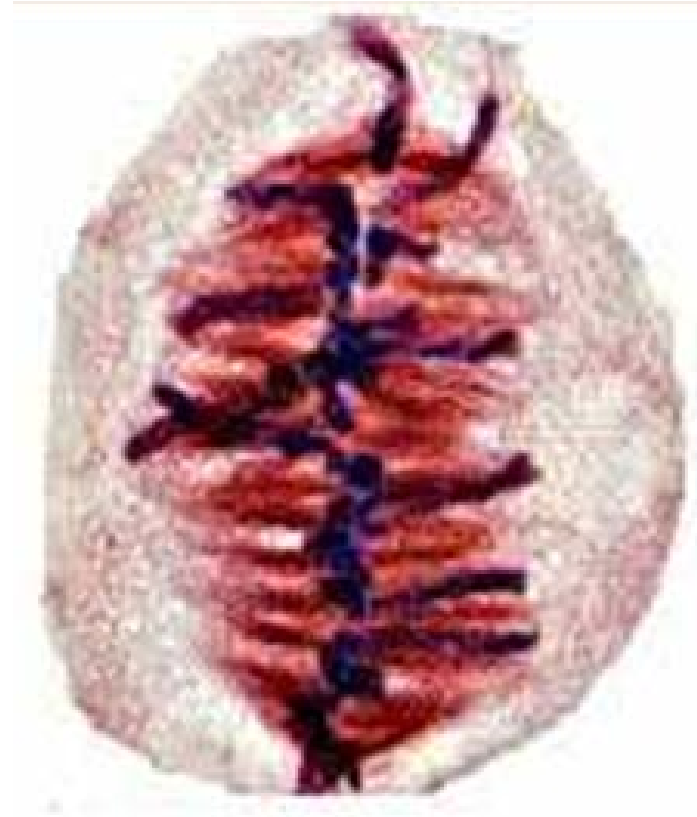
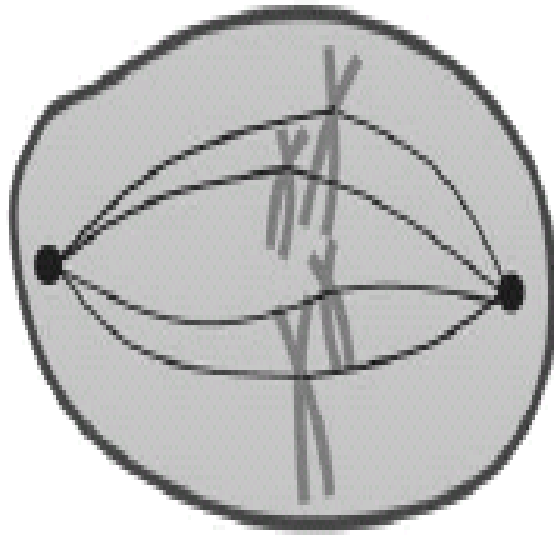


Prophase

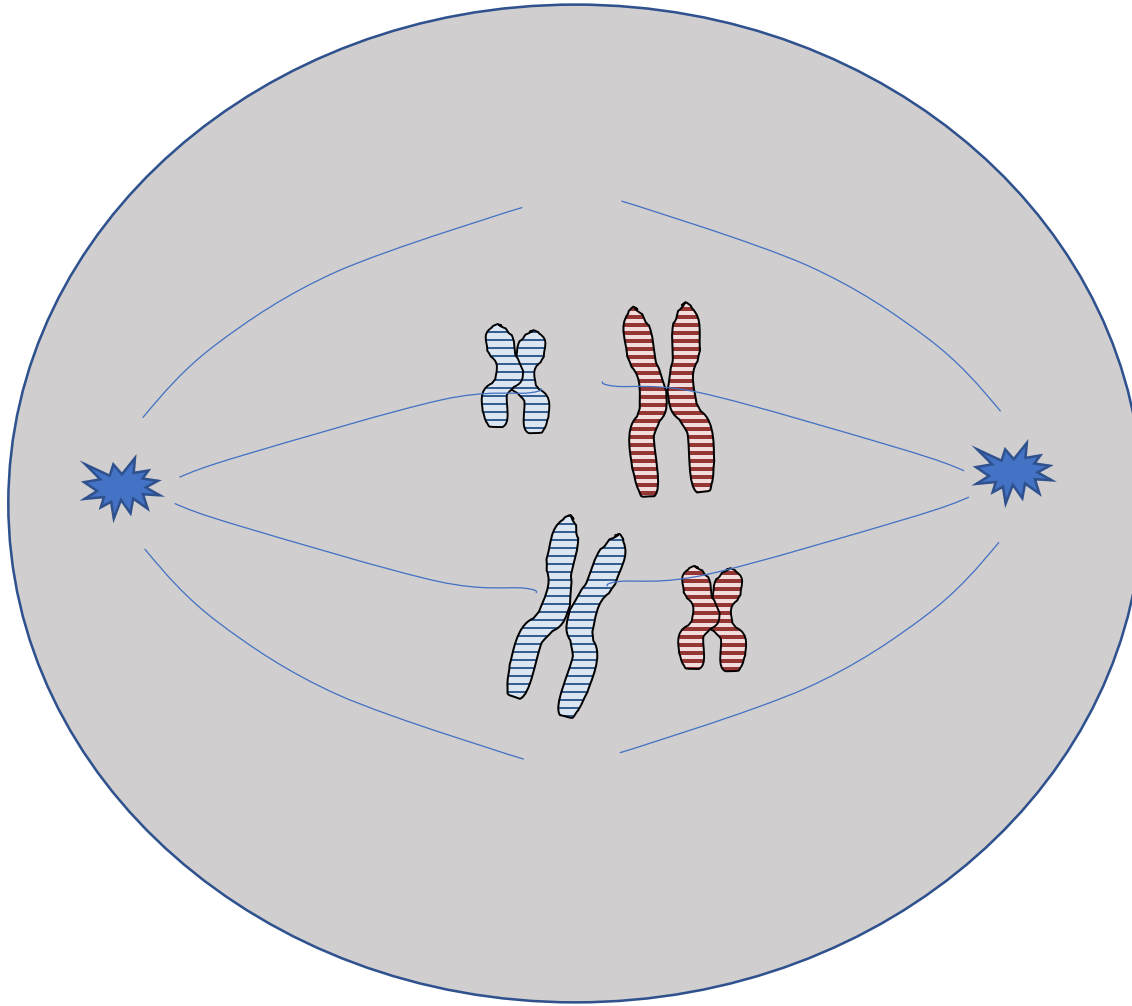


- Chromosomes shorten and thicken to become visible.
- (Chromosomes) appear as (two sister) chromatids joined at the centromere

Metaphase

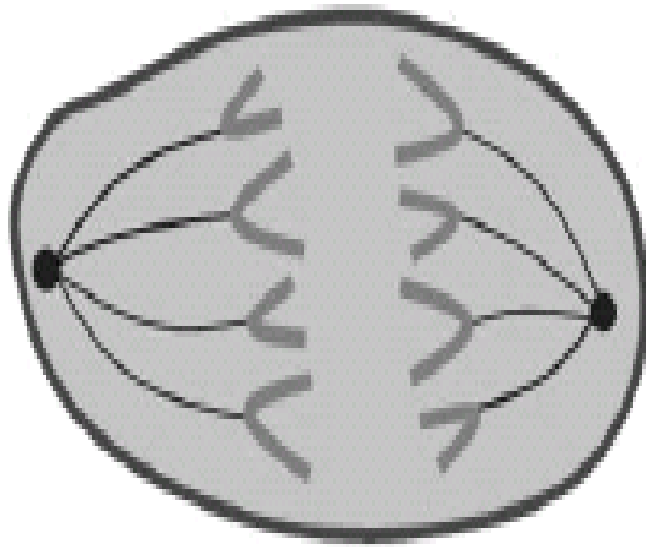


Metaphase

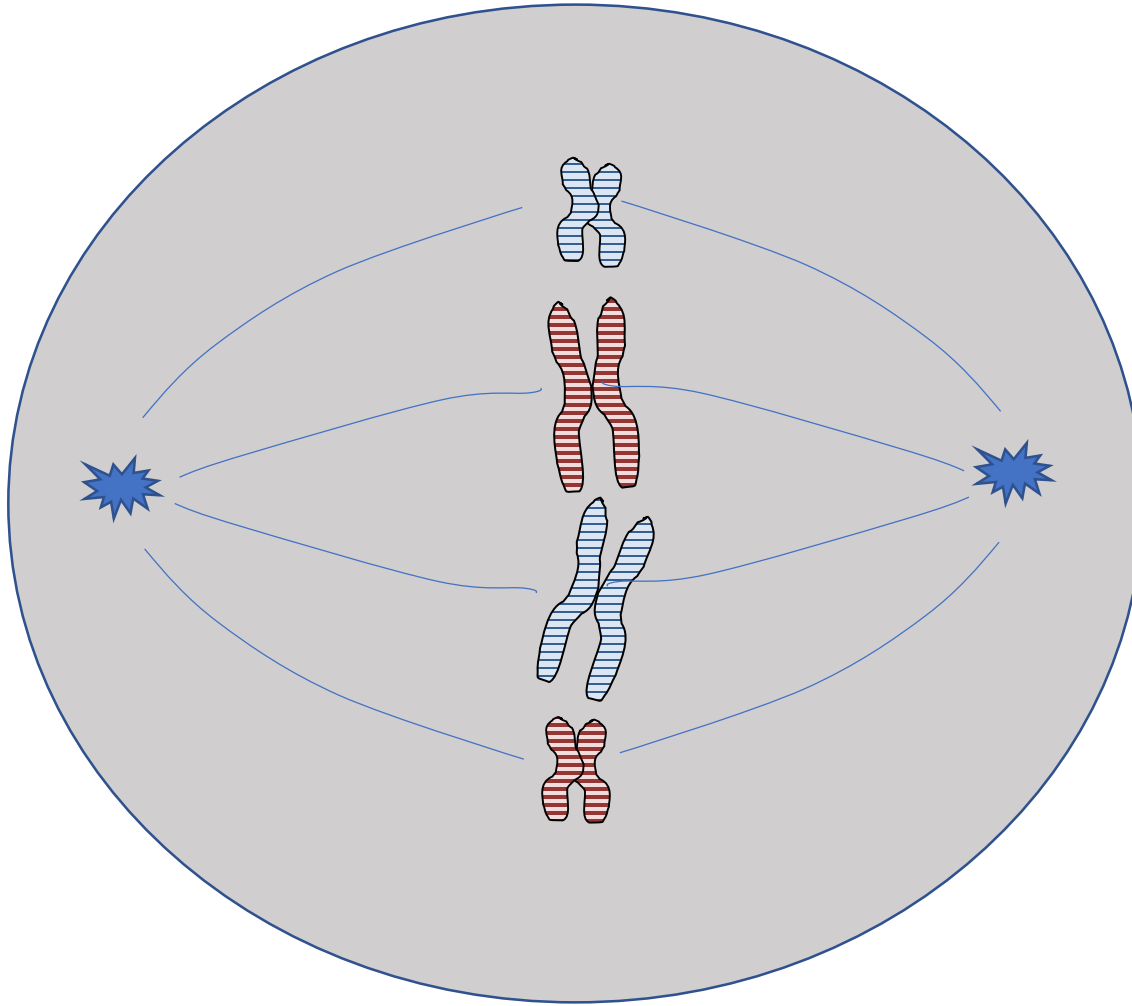


- Chromosomes line up on the equator.
- Chromosomes attached to spindle fibres by their centromere.

Anaphase

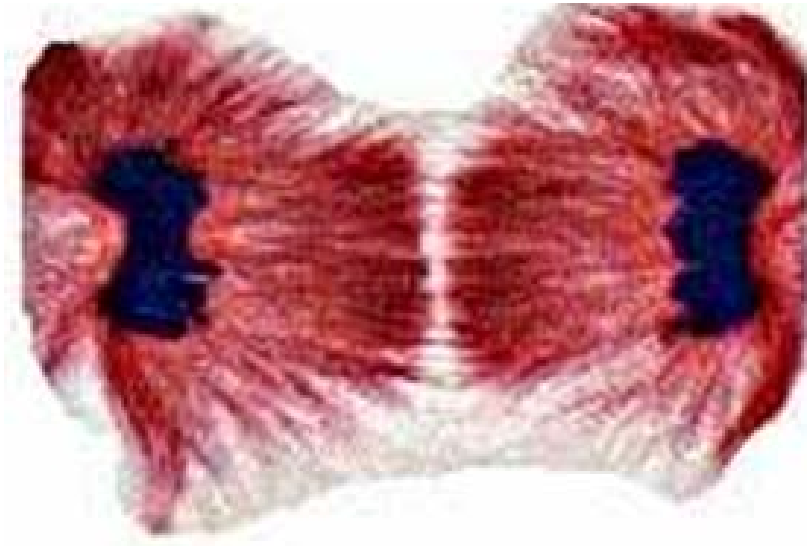
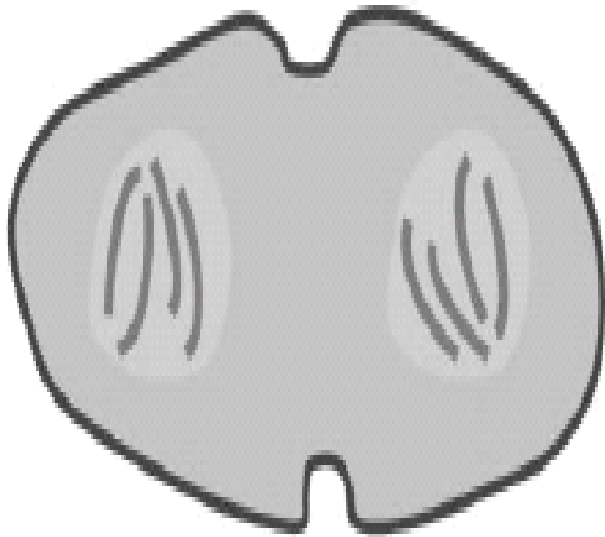


Anaphase

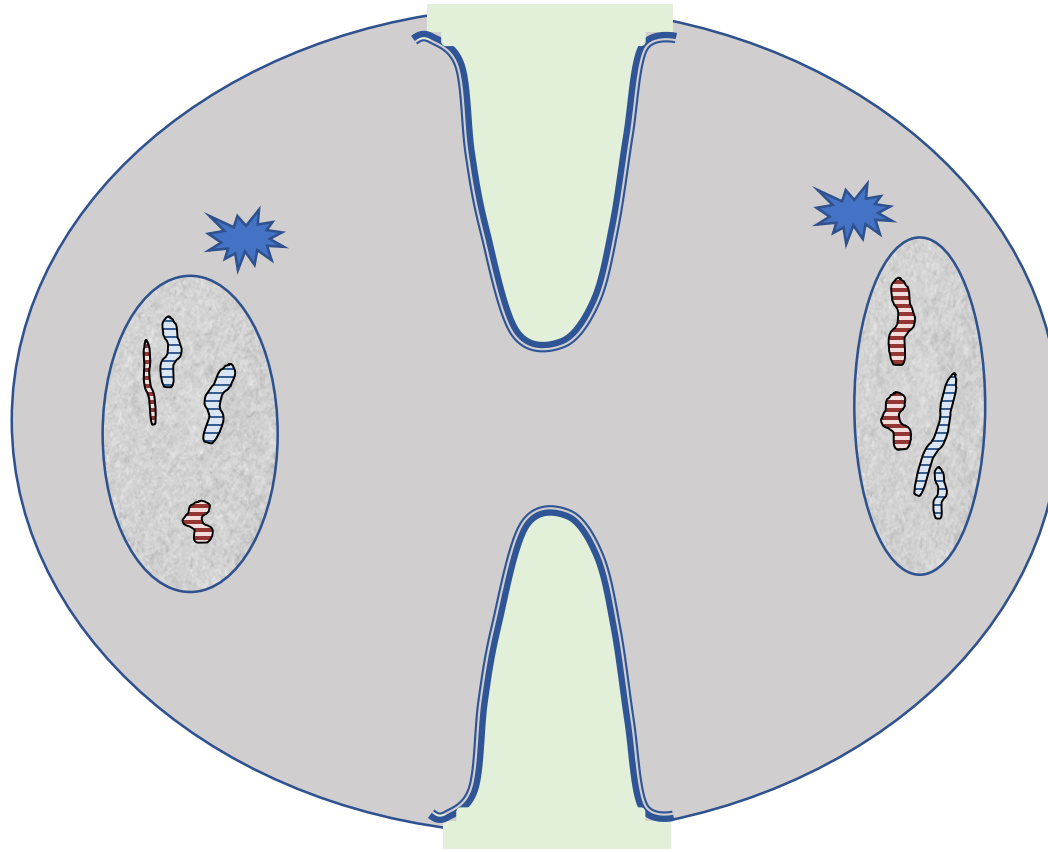


- The centromere splits.
- Sister chromatids are pulled to opposite poles.

Telophase



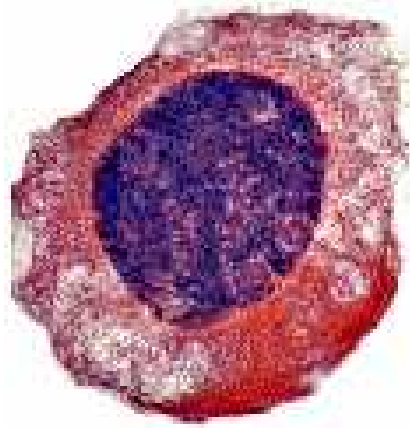
Telophase



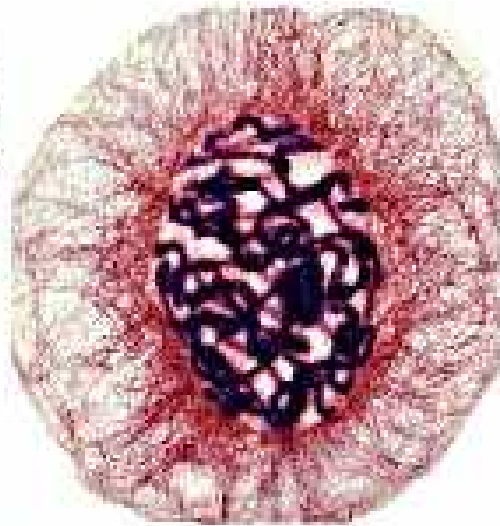
- Chromosomes uncoil and become thinner.
- Cytokinesis begins.

Mitosis- what is this stage?

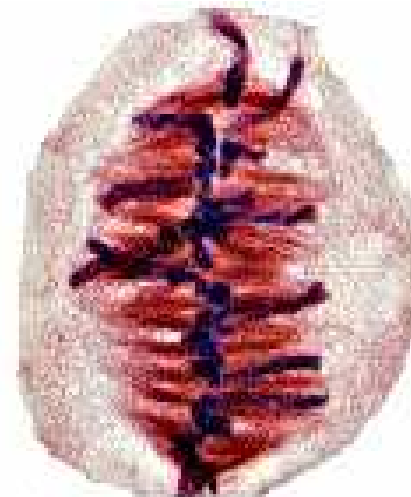
Whiteboards at the ready!



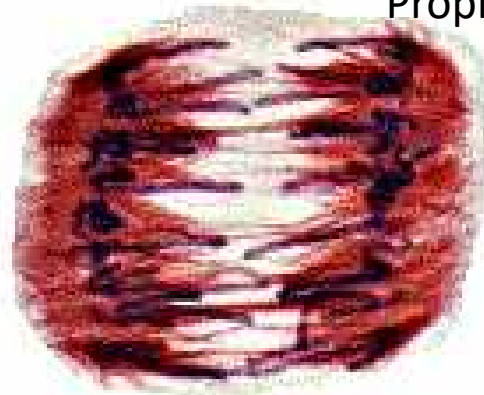
Interphase



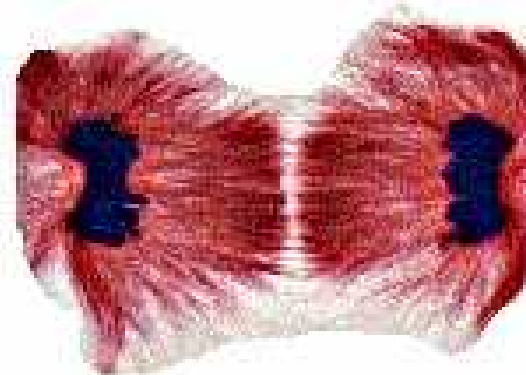
Prophase



Metaphase



Anaphase

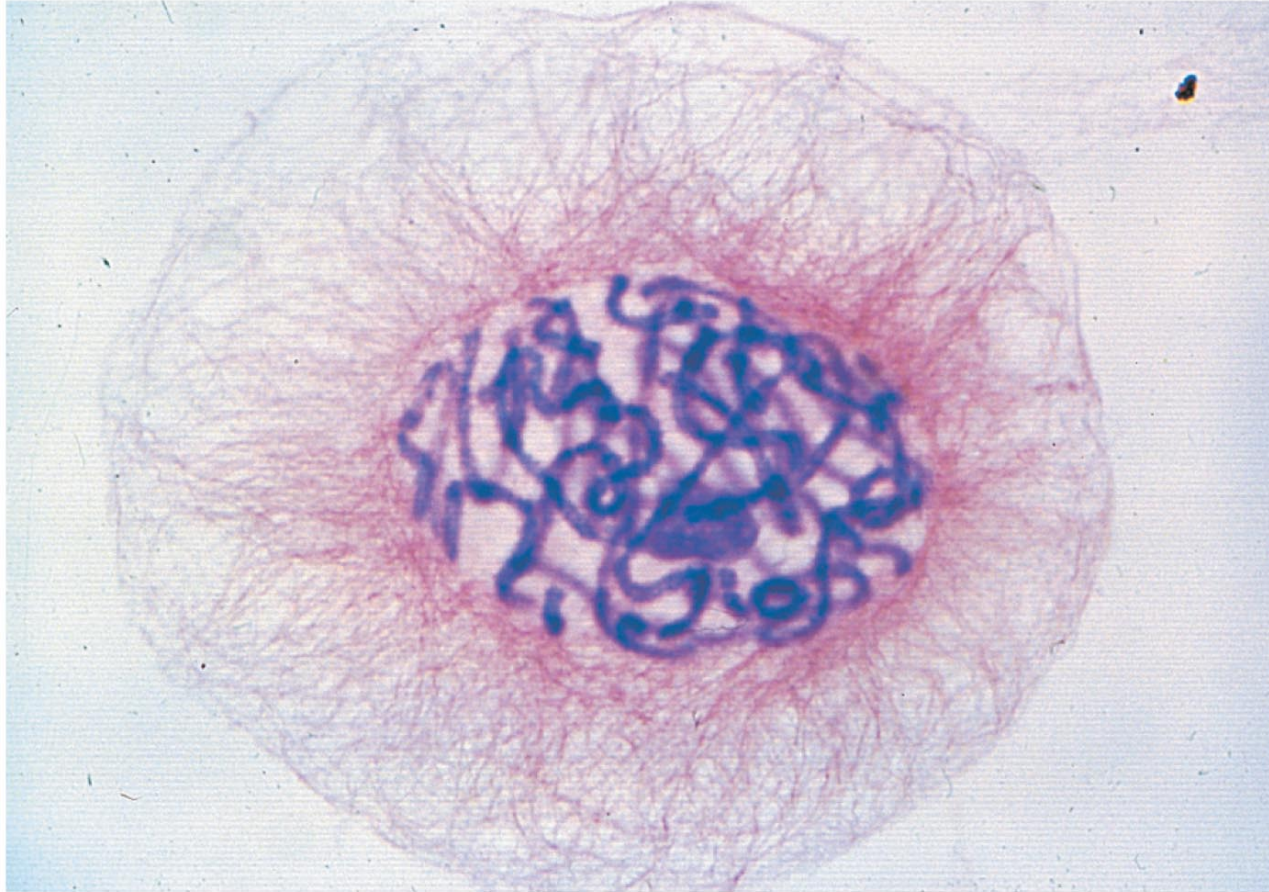


Telophase



What is
this
stage?

Metaphase



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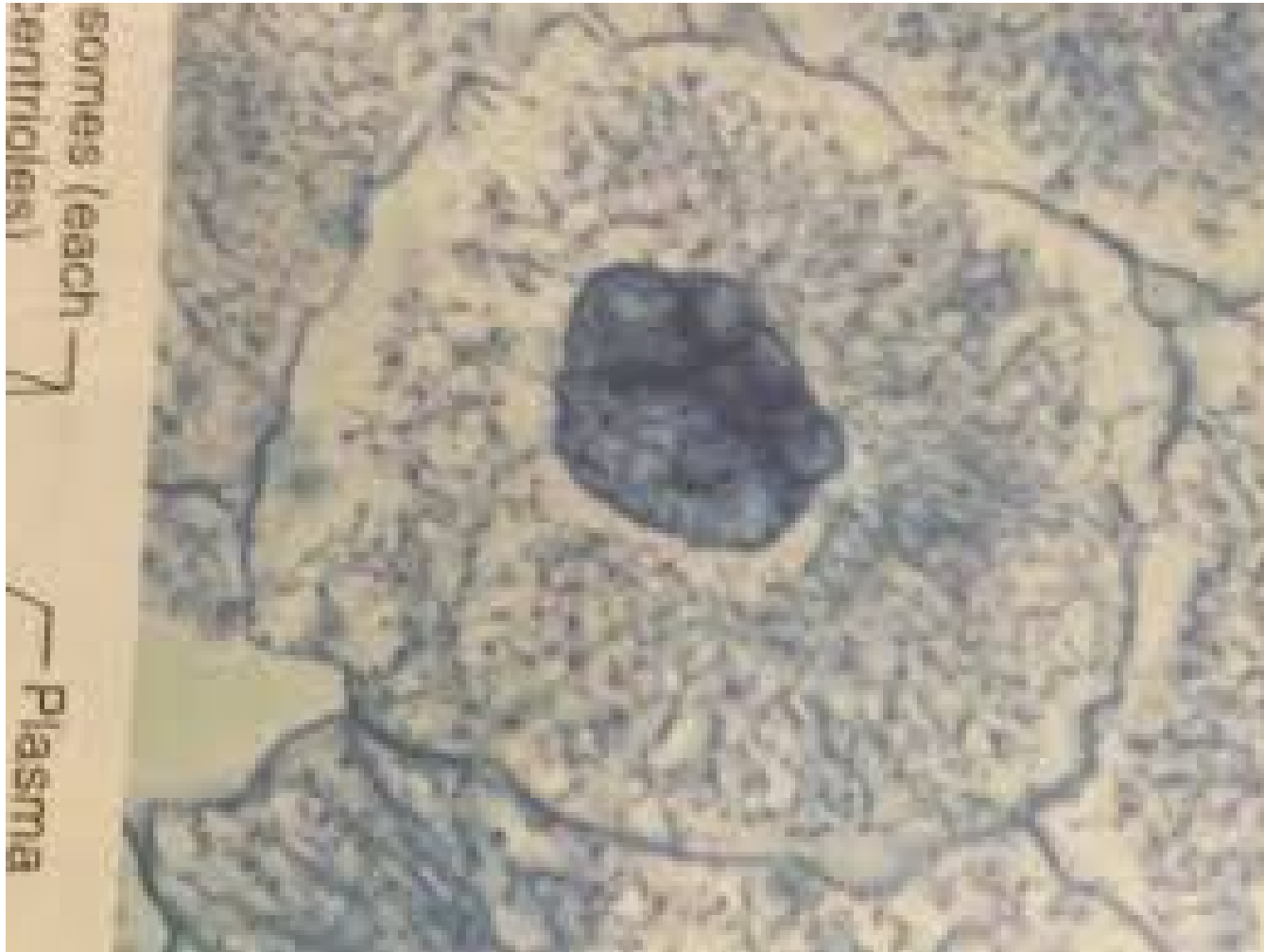
What is
this
stage?

Prophase



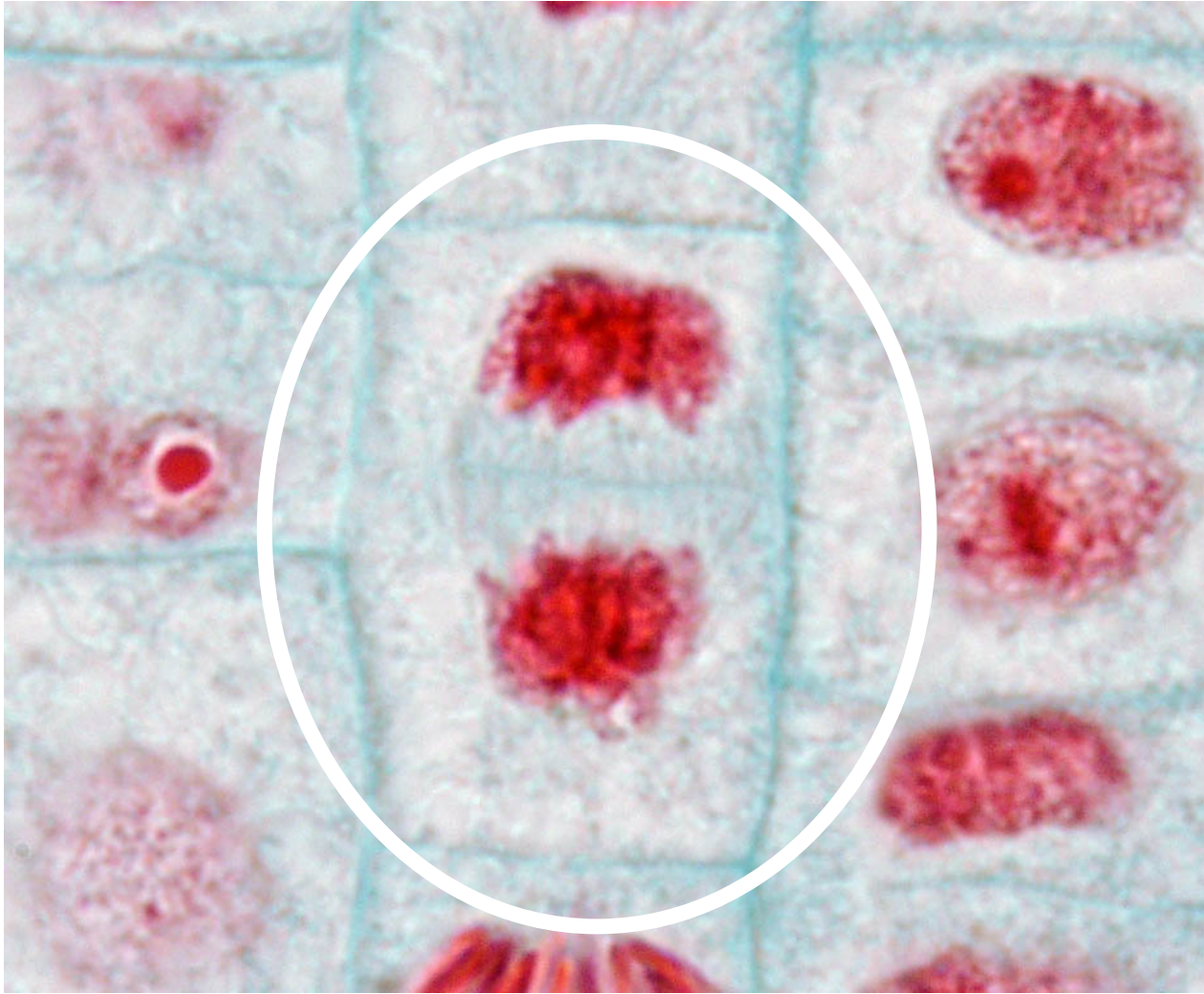
What is
this
stage?

Anaphase



What is
this
stage?

Interphase



What is
this
stage?

Telophase

Apply this knowledge to the exam questions on page 8-11.

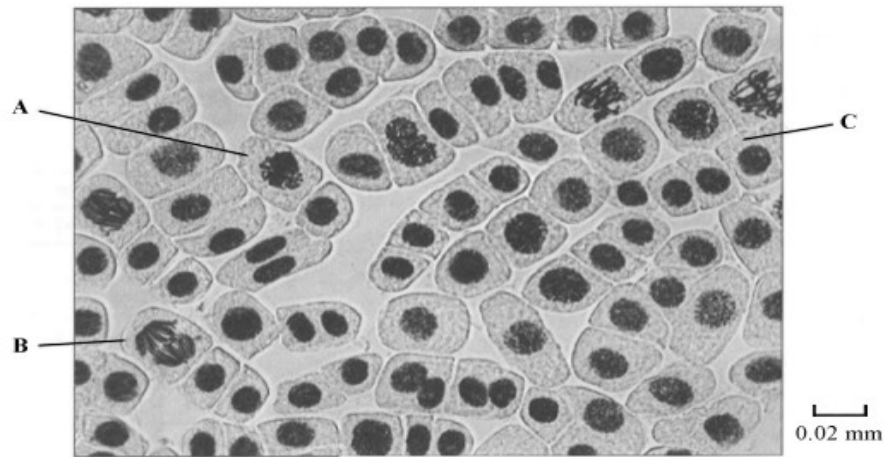
The questions are worth 18 marks. Can you complete the exam question in 23 minutes?

Once you have completed the question, check your answers using the markscheme.

Remember

1. Highlight which part of your answer is also on the markscheme. Allow you to see which part of your answer are relevant.
2. If it isn't on the mark scheme it is not right, if it isn't written as the markscheme it is not right.
3. In a different coloured pen add corrections to the question.
4. Anything you don't understand make a note of for when you speak to your teacher.

Q1. The photograph shows cells from an onion root tip. The root tip has been squashed and stained to show the stages of mitosis.



(a) (i) At what stage of mitosis is cell **A**?

_____ (1)

(ii) What is the evidence that cell **B** is in anaphase?

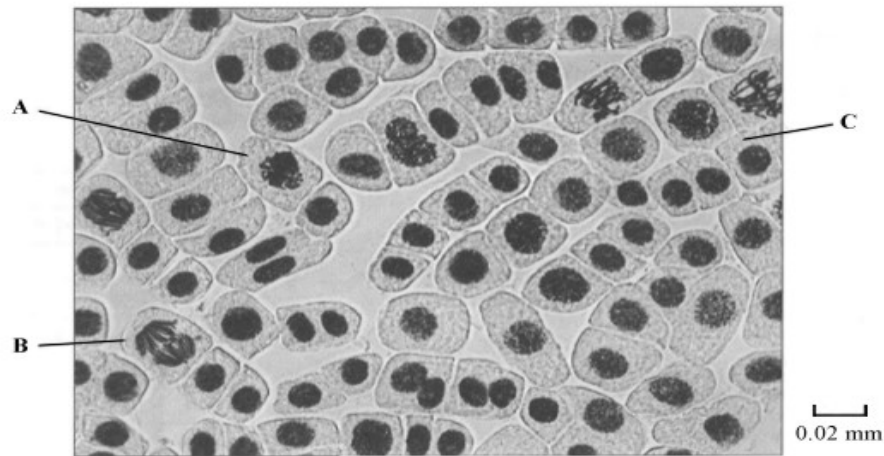
_____ (1)

Q1.

(a) (i) Prophase;
1

(ii) Chromosomes / chromatids moved apart;
1

Q1. The photograph shows cells from an onion root tip. The root tip has been squashed and stained to show the stages of mitosis.



(iii) Cell **C** is in interphase. Give **two** processes which occur during interphase that enable cell division to occur.

(iii) *A wide range of processes occurs during interphase. This list is by no means exhaustive, but we would expect to see answer such as:*

- Increase in volume of cell / volume of cytoplasm / increase in mass / cell bigger; increase in number of organelles;
- synthesis of protein / named protein;
- DNA replication / increase / chromosomes copied;
- ATP synthesis / respiration;

max 2

(b) Explain how you would calculate the magnification of the photograph.

(b) Divide real length of bar (in mm) / 10 by 0.02; (1)

(c) The number of cells at each stage of mitosis was counted. The results are shown in the table.

Stage of mitosis	Number of cells
Interphase	123
Prophase	32
Metaphase	12
Anaphase	6
Telophase	27

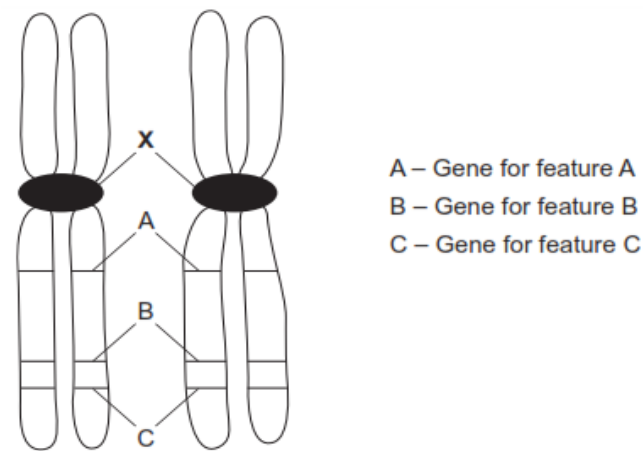
One complete cell cycle takes 24 hours. The number of cells at each stage is proportional to the time spent at that stage. Calculate the length of time spent in metaphase. Show your working.

Answer _____ hours **(2)**

(c) 12 / 200 × 24 / single error in otherwise correct method;

1.44 hours (1 hour 26 min);

Q2.The diagram shows two chromosomes in a cell undergoing mitosis.



(a) Name X.

(a) Centromere; (1)

(b) These are homologous chromosomes. Give **two** pieces of evidence from the diagram that support this.

1. _____

2. _____

_____ (2)

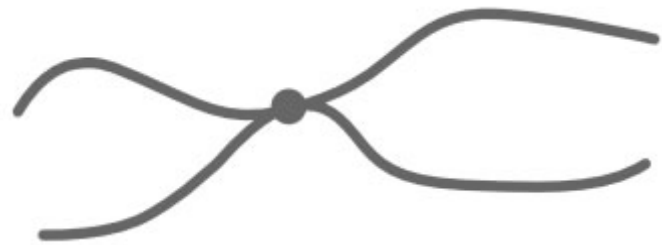
(b) Same size;
Same shape;
Same genes;
In same sequence/locus/loci;

(c) What will happen to these chromosomes in anaphase?

(2)

(c) Chromatids separate;
(Chromatids) pulled to opposite ends of cell;
By spindle fibres;
Become part of new nuclei;

Q3.(a) The diagram shows a chromosome at the start of mitosis.



Describe and explain the appearance of the chromosome.

(2)

(a) DNA replicated/two DNA strands/molecules;
Coiled/condensed/wound up (to make visible);
Giving/made of (two) chromatids;
Attached at centromere; *Accept linear so eukaryote; with histone; Accept have become shorter and fatter*

(b) The photographs show two stages in mitosis.

Stage A



Stage B



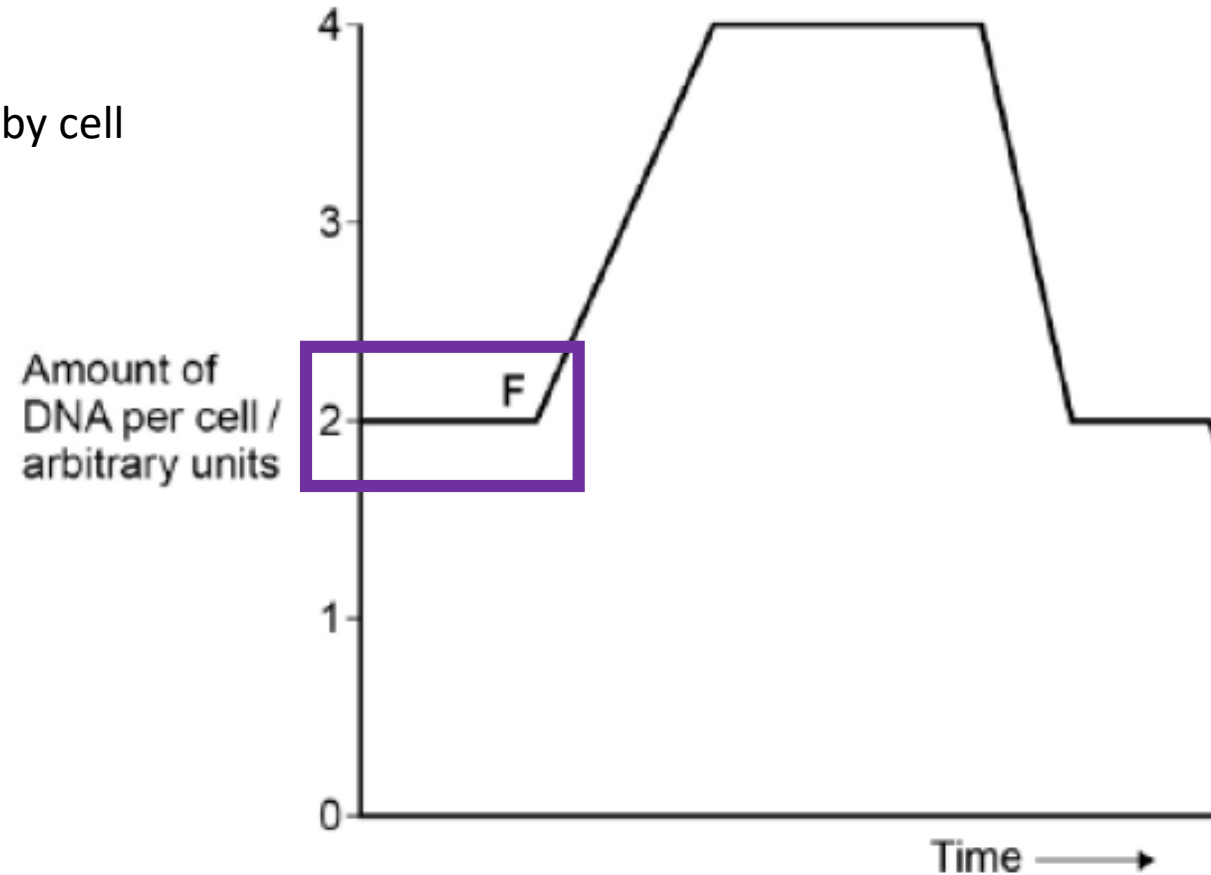
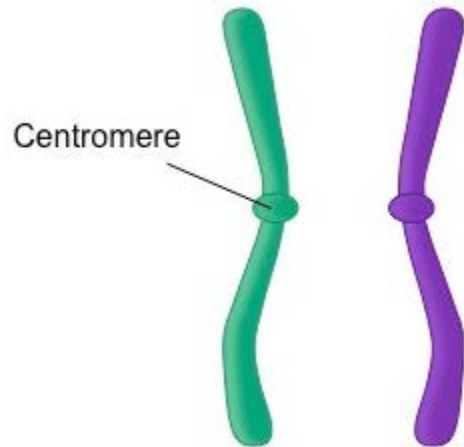
Name stages **A** and **B**. Describe what is happening to the chromosomes in each stage.

- (i) Stage **A**
- _____ (b) (i) Stage **A**, prophase/Metphase;
chromosomes condensed/coiled/wound up;
_____ *Points not linked but need correct description with stage in this case.*
_____ Chromosomes on equator/attaching to spindle;
_____ *Points not linked*
_____ *Accept equator of cell*
_____ *Reject centre of cell*
- (ii) Stage **B**
- _____ *Accept chromatids for chromosomes*
- _____ (ii) Stage **B**, anaphase;
_____ Chromatids pulled to poles
_____ Spindle fibres

DNA volume inside cells

This is not in your booklet. Add these notes to page 6.

2 au: **Before DNA is replicated.**
Single chromosomes
Not yet called chromatids as not replicated.
Contains all the genetic information needed by cell



DNA volume inside cells

This is not in your booklet. Add these notes to page 6.

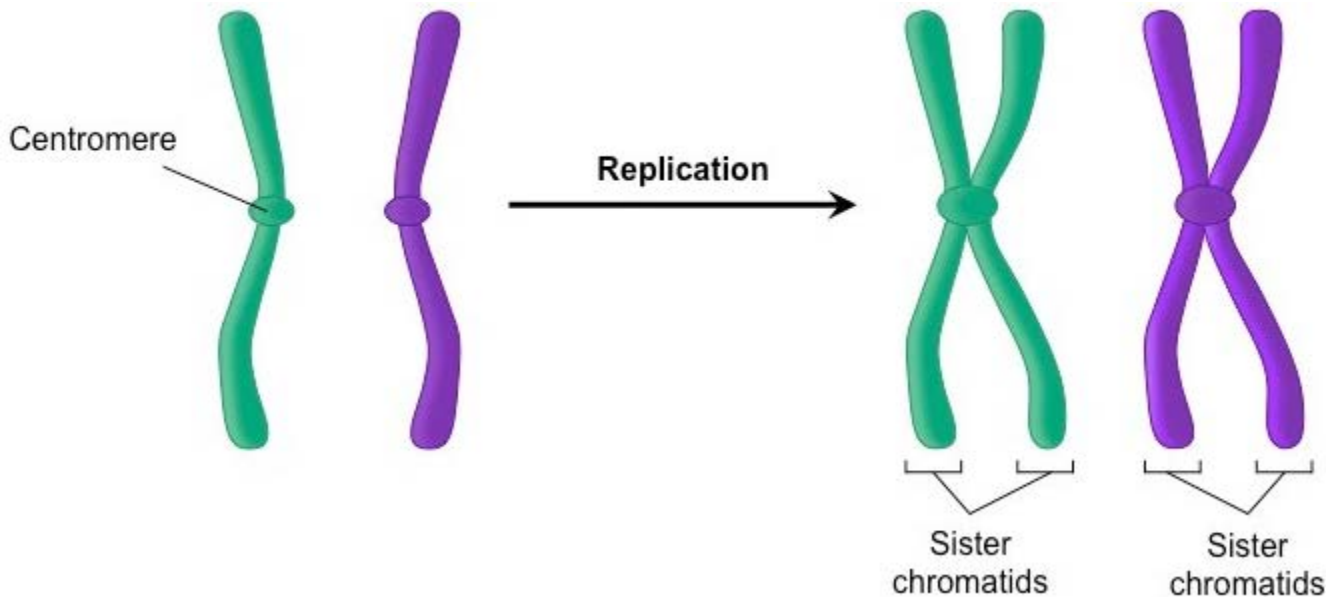
4 au: **After DNA is replicated.**

Chromosomes

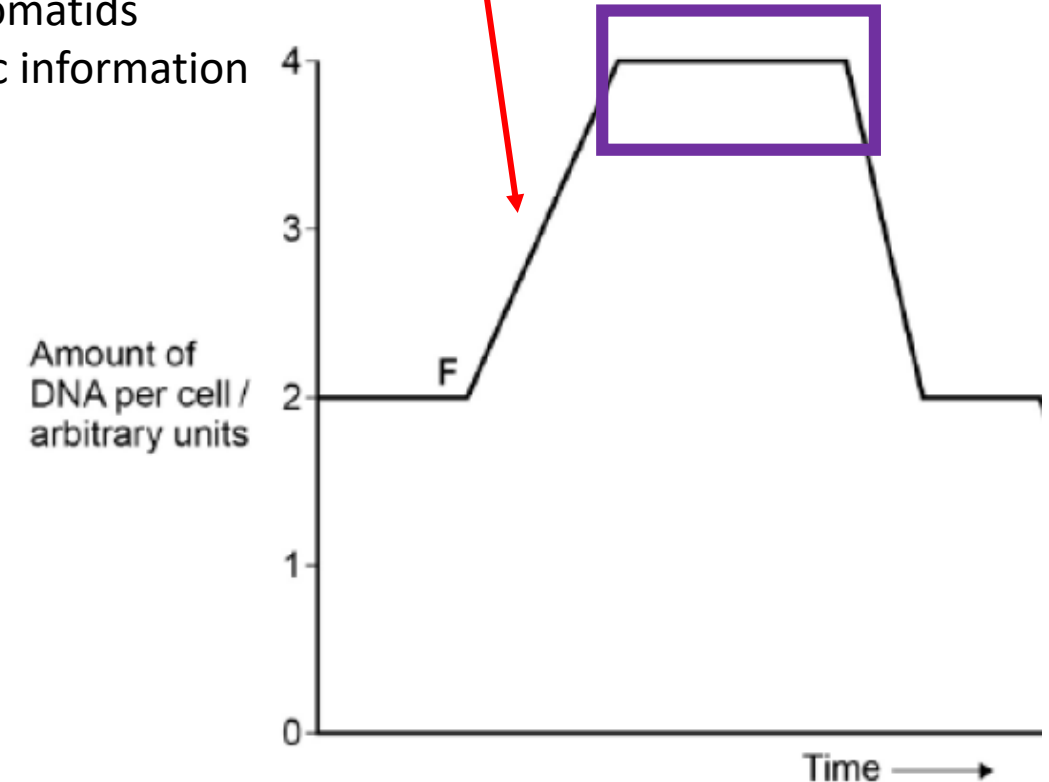
DNA has been replicated so chromosomes contain 2 sister chromatids

Each chromatid is genetically identical so contain SAME genetic information

DNA volume has doubled. Genetic information is the same



Process of semi-conservative replication



DNA volume inside cells

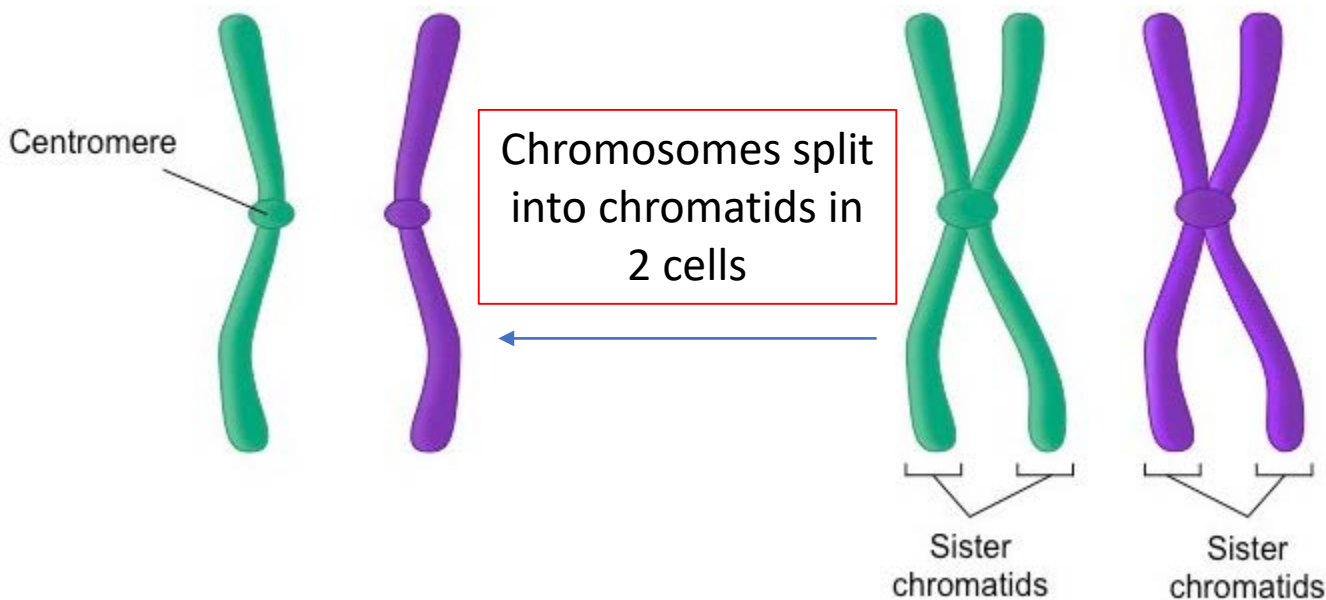
This is not in your booklet. Add these notes to page 6.

4-2 au: **Mitosis has occurred**

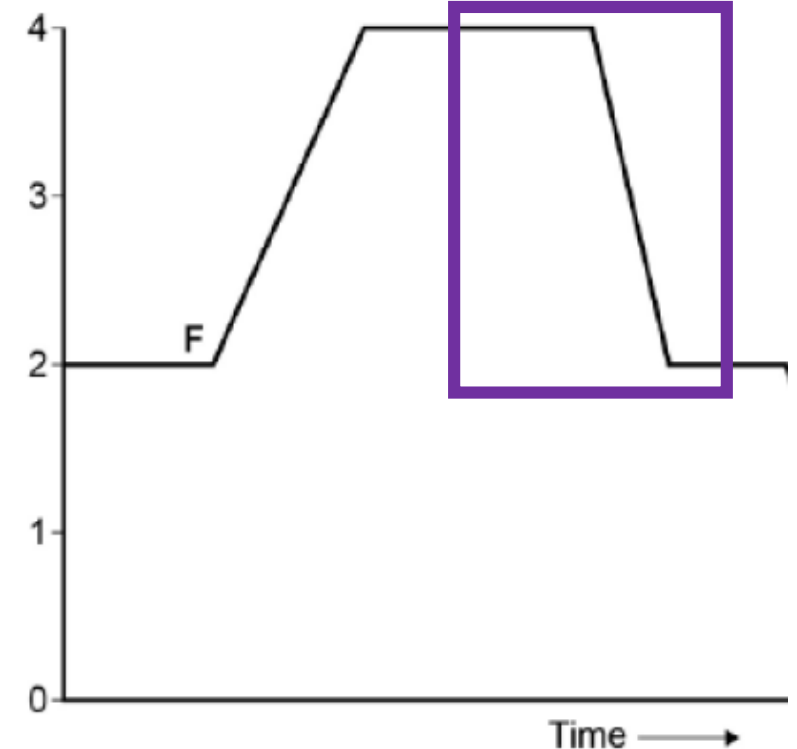
Chromosomes are split back into separate chromatids.

Each chromatid is genetically identical so contain SAME genetic information inside each cell

DNA volume has halved. Genetic information is the same



Amount of
DNA per cell /
arbitrary units



IMPORTANT: Volume/amount/mass of DNA is NOT the same as DNA content.