Mitotic Figures

Catherine Conway

14-Jan-013

All digital images at 40x

Mitosis Background

- Mitosis means cell division, it is the process by which cells reproduce.
- Cells undergoing mitosis are called Mitotic Figures.
- Instead of a nucleus the chromosomes are visible as tangled, dark-staining threads in Mitotic Figures

http://www.gistsupport.org/for-new-gist-patients/understanding-your-pathology-report-for-gist/pathology-analyses-for-gist.php

http://www.pathguy.com/histo/015.htm

Stages of Mitosis

- There are four stages in Mitosis.
- Three of the stages occur in a single cell.
- In the final stage one cell is visibly dividing into two.

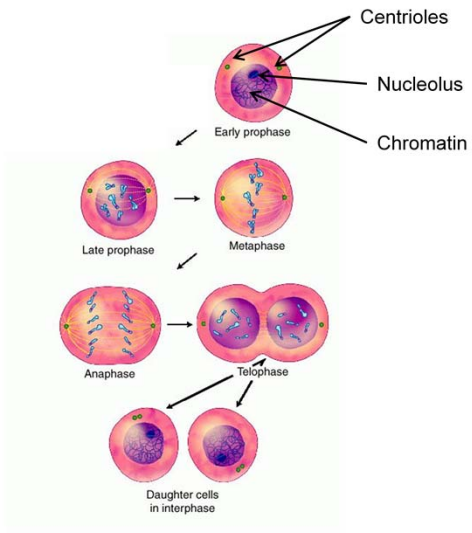


Figure 1: *Stages of Mitosis.* Represents the stages of Mitosis. Prophase, Metaphase, Anaphase and Telophase

http://medical-dictionary.thefreedictionary.com/mitosis

http://www.pathguy.com/histo/018.htm

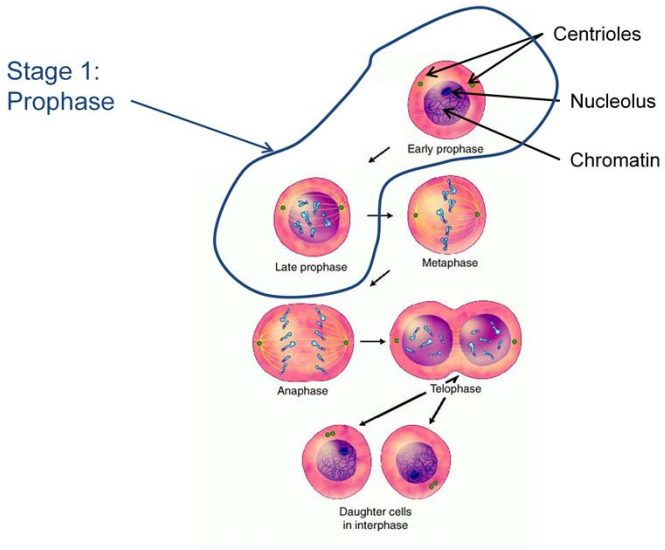


Figure 1: *Stages of Mitosis.* Represents the stages of Mitosis. Prophase, Metaphase, Anaphase and Telophase

http://medical-dictionary.thefreedictionary.com/mitosis

http://www.pathguy.com/histo/018.htm

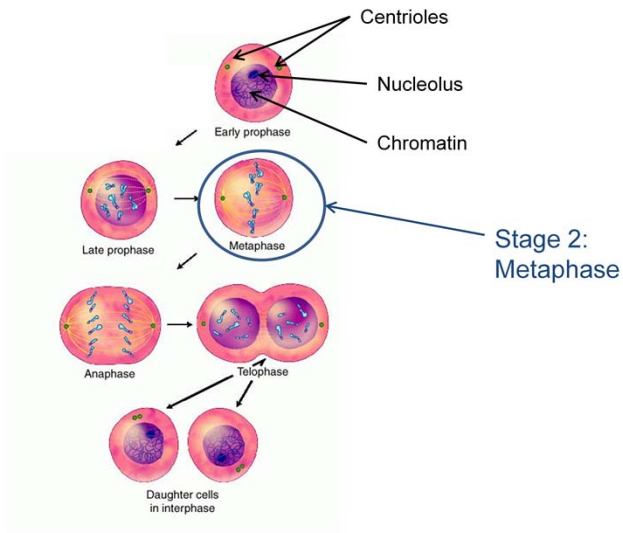


Figure 1: *Stages of Mitosis.* Represents the stages of Mitosis. Prophase, Metaphase, Anaphase and Telophase

http://medical-dictionary.thefreedictionary.com/mitosis

http://www.pathguy.com/histo/018.htm

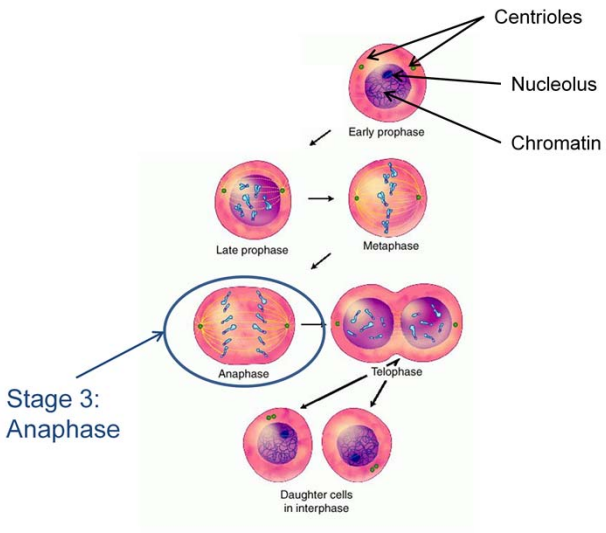


Figure 1: *Stages of Mitosis.* Represents the stages of Mitosis. Prophase, Metaphase, Anaphase and Telophase

http://medical-dictionary.thefreedictionary.com/mitosis

http://www.pathguy.com/histo/018.htm

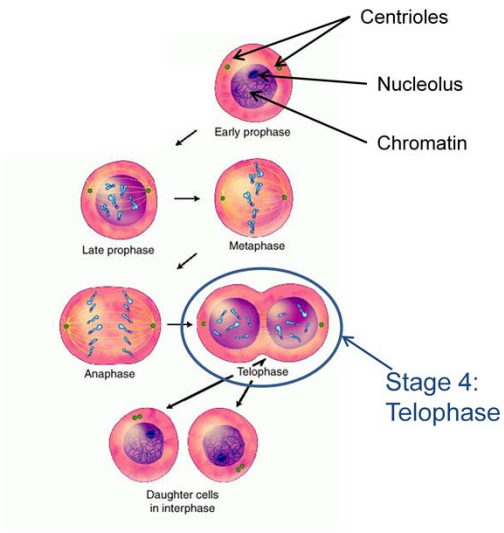


Figure 1: *Stages of Mitosis.* Represents the stages of Mitosis. Prophase, Metaphase, Anaphase and Telophase

http://medical-dictionary.thefreedictionary.com/mitosis

http://www.pathguy.com/histo/018.htm

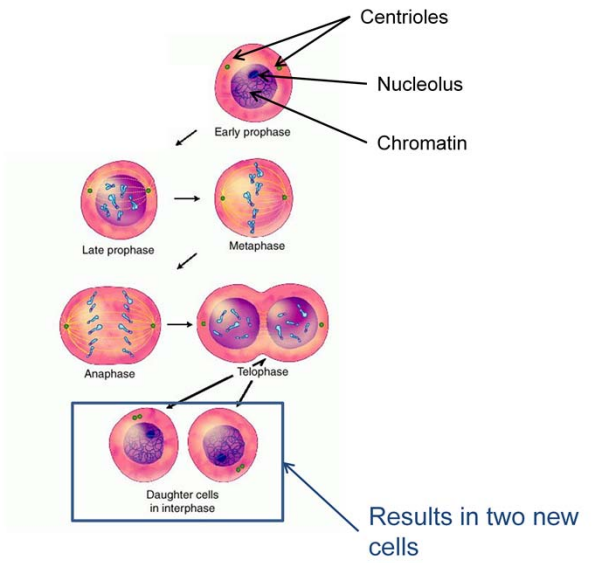


Figure 1: *Stages of Mitosis.* Represents the stages of Mitosis. Prophase, Metaphase, Anaphase and Telophase

http://medical-dictionary.thefreedictionary.com/mitosis

http://www.pathguy.com/histo/018.htm

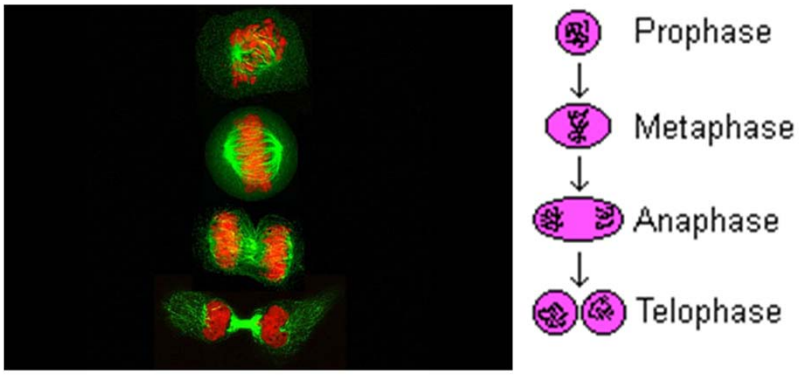


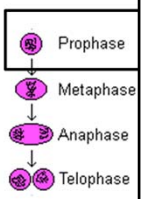
Figure 2: Fluorescent representation of the stages of Mitosis. Prophase, Metaphase, Anaphase and Telophase

Prophase

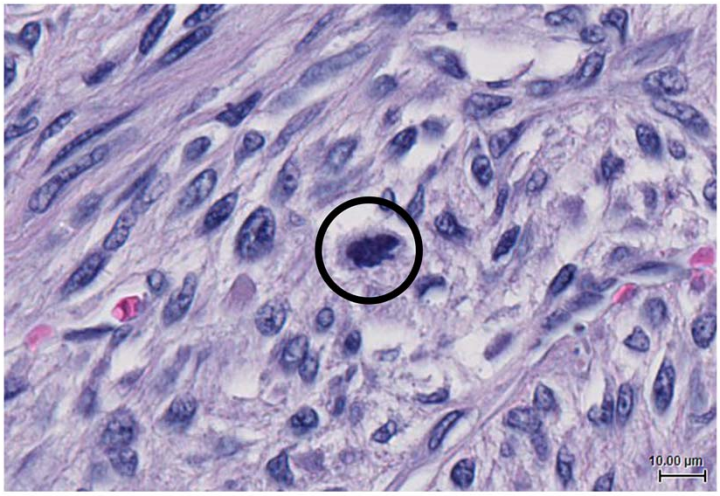
- ***Appearance:*** **Instead of a nucleus there is a mass of darkly colored spindles taking up almost the entire cell area. Cells may be larger than the surrounding cell size, but not always.**
- During prophase, the cell prepares the equipment it needs to separate its genetic material.
- The cell has completed interphase, which means that the DNA has been duplicated and is condensed and packaged into chromosomes, the nuclear envelope begins to break down and the mitotic spindle forms at opposite ends of the cell.
- The spindle, which is made of microtubules, is the structure that is required to separate the chromosomes and pull them into two distinct sets.

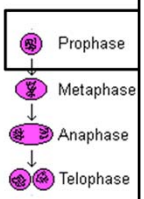
Computer-generated illustration showing a cell at prophase.

Prophase



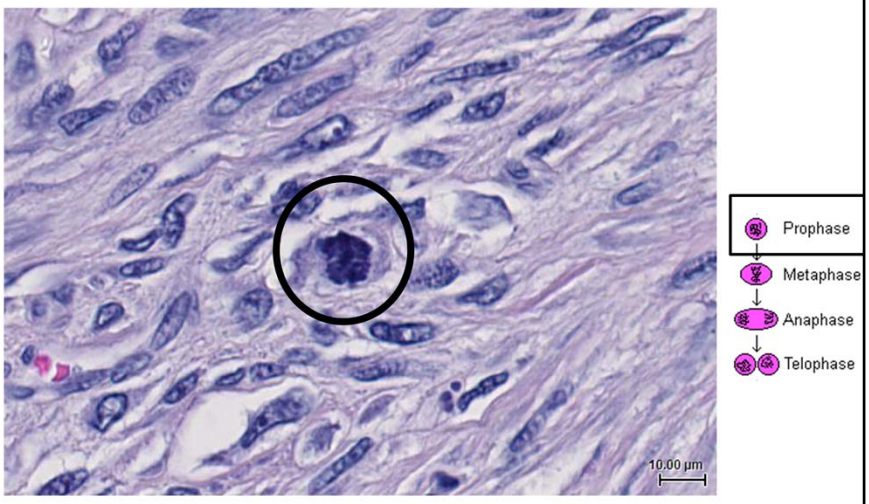
Prophase





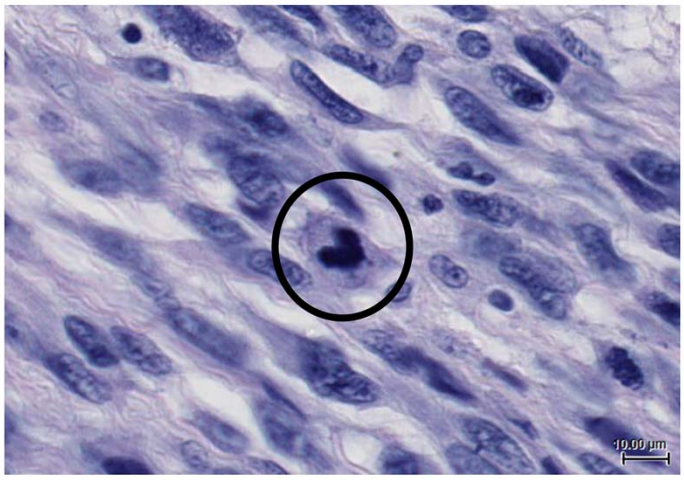
Spindle takes up the majority of the cell area and is much darker in color than the surrounding cells

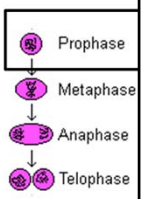
Prophase



Spindle does not take up as much of the cell area as the previous images, but it clearly takes up much more of the cell than the surround cells nuclei and is much darker in color

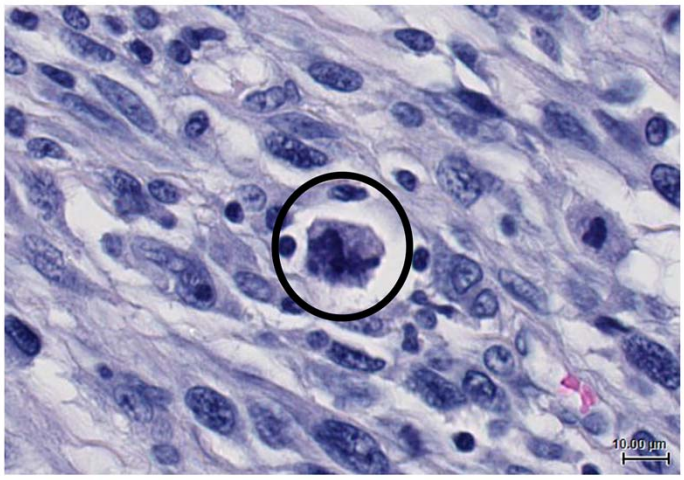
Prophase

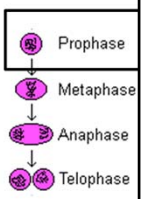




Spindle is not a perfect circle but it takes up the majority of the area of the cell and is darker in color than the surrounding cell nuclei

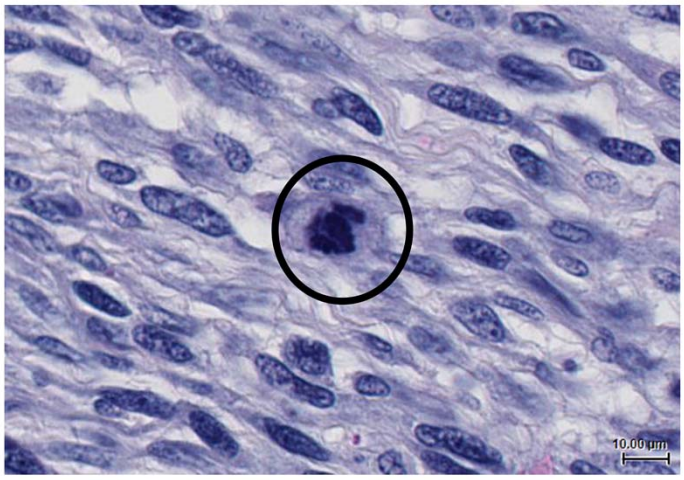
Prophase

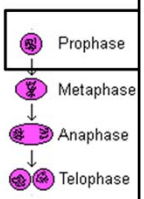




Spindle is not a perfect circle but it takes up the majority of the area of the cell and is darker in color than the surrounding cell nuclei

Prophase

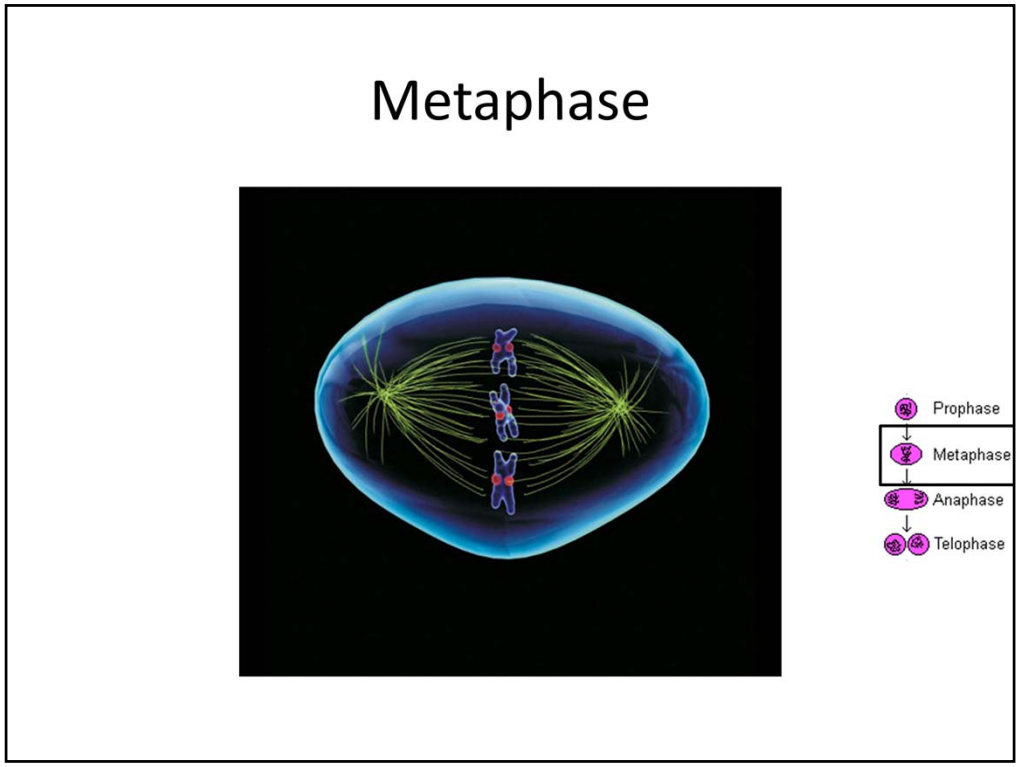




Spindle is not a perfect circle but it takes up the majority of the area of the cell and is darker in color than the surrounding cell nuclei

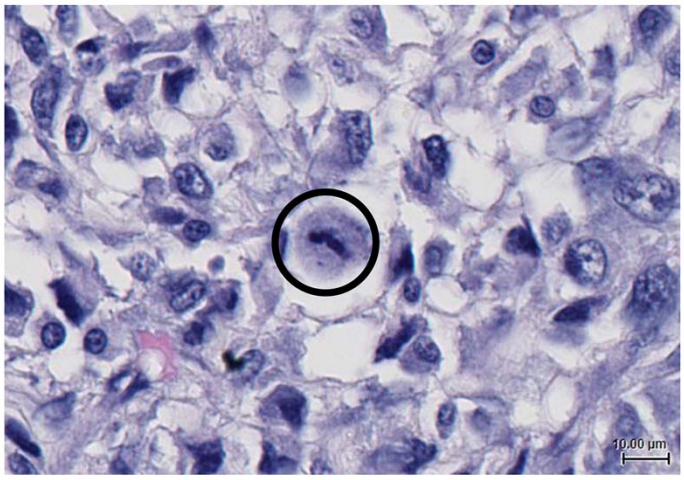
Metaphase

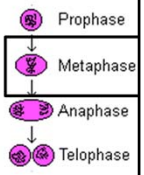
- ***Appearance:*** **Instead of a nucleus there will be a single line of darkly colored spindles taking up a large portion of the cell.**
- During metaphase, the chromosomes are attached to the mitotic spindle.
- The chromosomes (which consist of two chromatids) line up along the central region of the spindle.
- The mass of spindles **may not always appear in the centre region of the cell**, as that will depend on how the tissue is sectioned.



Computer-generated illustration of a cell at metaphase. This stage follows prometaphase and indicates completion of chromosome alignment. During metaphase, the chromosomes are attached to the mitotic spindle via protein complexes called kinetochores. The chromosomes (which consist of two chromatids) line up along the central region of the spindle, called the metaphase plate, so that the sister chromatids face opposite poles. Credit: Benedict Campbell, Wellcome Images.

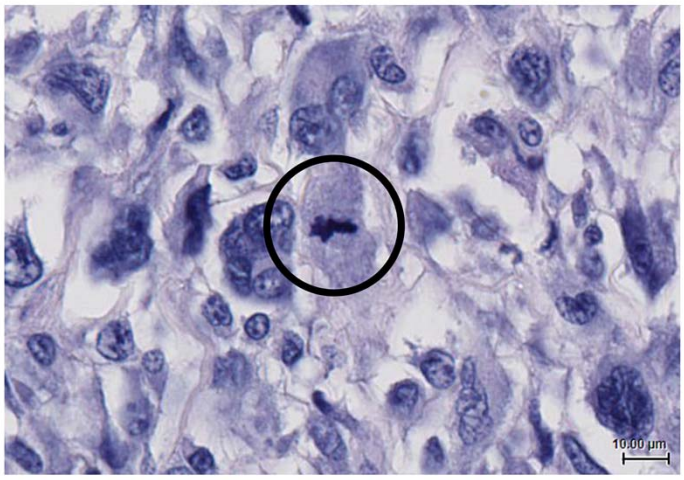
Metaphase

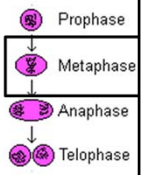




Spindle has aligned in the cell, it takes up less area of the cell compared to the previous phase but it still appears very dark in color compared to the surrounding nuclei

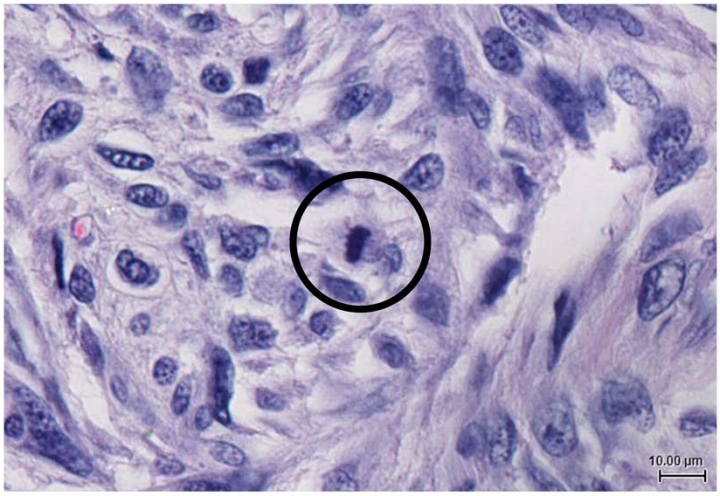
Metaphase

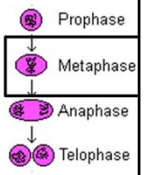




It does not have to be a perfect line in order to be in metaphase, above the spindle has aligned in the cell

Metaphase





Spindle has aligned in the cell, it is much larger than the previous two examples of metaphase

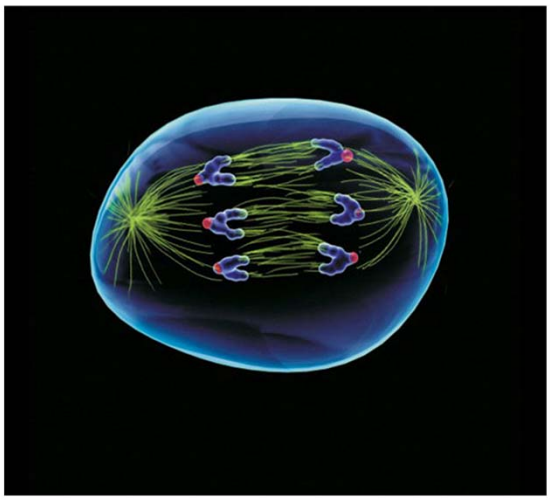
Anaphase

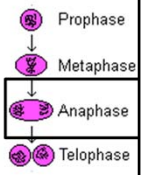
- ***Appearance:*** **Instead of a single spindle, there are now two. The spindles do not have to be identical in size. However, they will both be a darker color than the nuclei in the surrounding cells. The cell maybe larger than surrounding cells, but it does not have to be.**

- At this stage, the paired chromatids that make up each chromosome separate and are visible moving to opposite poles of the cell.

Computer-generated illustration of a cell at anaphase.
Credit: Benedict Campbell, Wellcome Images.

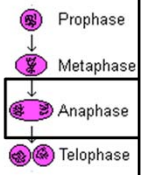
Anaphase





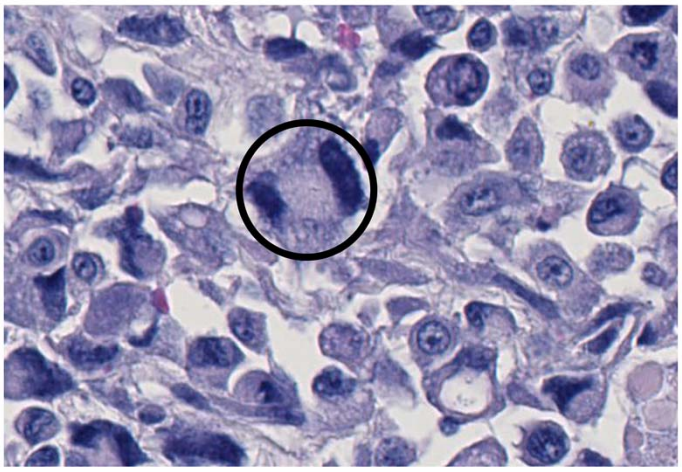
Computer-generated illustration of a cell at anaphase. At this stage, the paired chromatids that make up each chromosome separate and are visible moving to opposite poles of the cell. The next phase, telophase, begins when the chromatids reach the end of the spindle. Credit: Benedict Campbell, Wellcome Images.

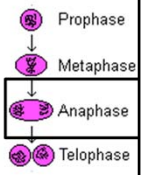
Anaphase



Two spindles are visible, both are darker in color than the surrounding nuclei

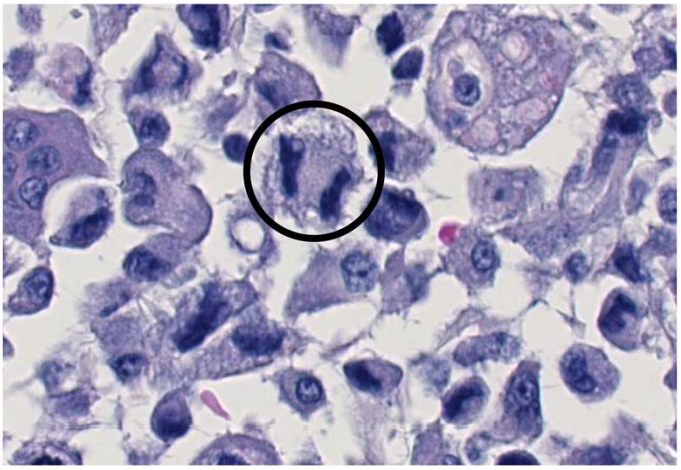
Anaphase

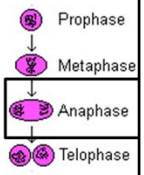




Two spindles are visible, both are darker in color than the surrounding nuclei, but they are not identical in size

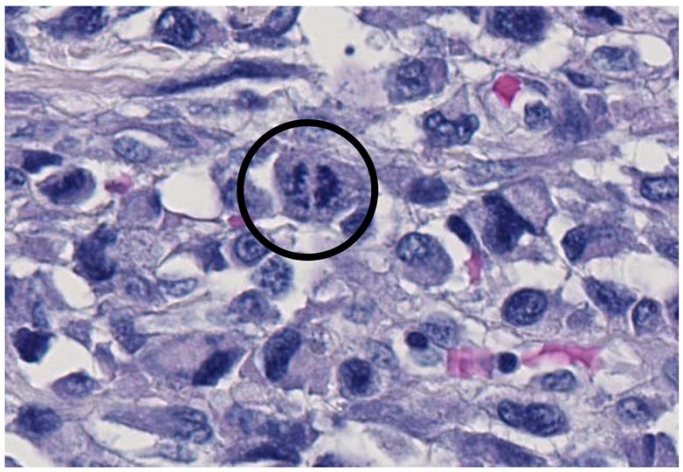
Anaphase

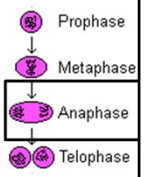




Two spindles are visible, both are darker in color than the surrounding nuclei

Anaphase



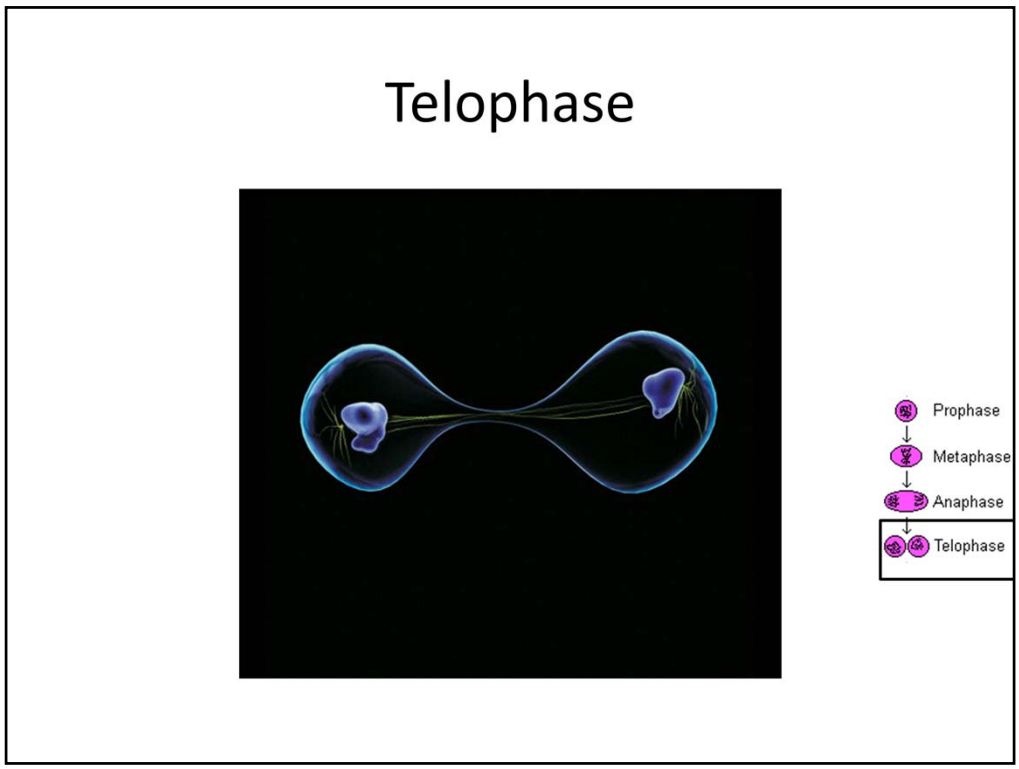


Two spindles are visible, both are darker in color than the surrounding nuclei, but they are not identical in size, and they are not as structured as previous examples

Telophase

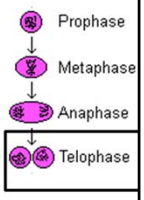
- ***Appearance:*** **Instead of a single spindle, there are now two. The spindles do not have to be identical in size. However, they will both be a darker color than the nuclei in the surrounding cells. Telophase looks similar to Anaphase, however two cells are visibly forming.**
- Once the duplicated chromosomes have separated, the **nuclear membranes start to form around them** and the chromosomes start to unravel.
- Then, the **cell begins to divide and the cytoplasm of the original cell starts to split**. This is the final step in forming two new identical daughter cells.

Computer-generated illustration of a cell at telophase.



Computer-generated illustration of a cell at telophase. Once the duplicated chromosomes have separated, the nuclear membranes start to form around them and the chromosomes start to unravel. Then, the cell begins to divide and the cytoplasm of the original cell starts to split. This process, known as cytokinesis, is the final step in forming two new identical daughter cells.

Telophase

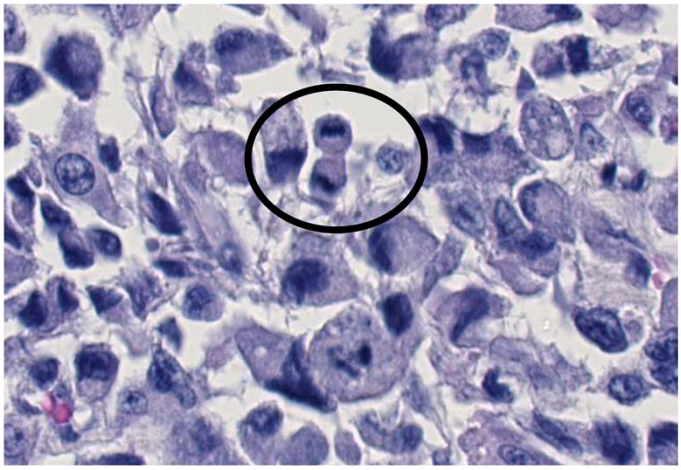


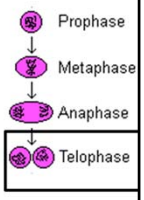
Two spindles are visible, both are darker in color than the surrounding nuclei. The formation of two individual cells are visible, but the cells are not separated yet.

Sarcoma slide 1: Ref:

http://www.wellcome.ac.uk/Education-resources/Teaching-and-education/Big-Picture/All-issues/The-Cell/Image-galleries-Aspects-of-imaging/WTDV030896.htm

Telophase



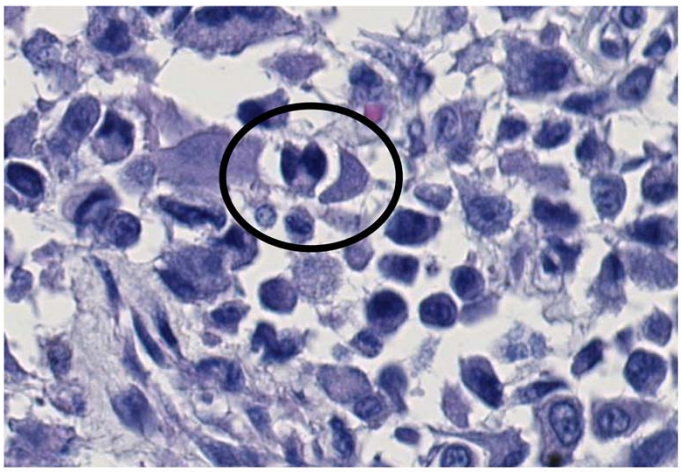


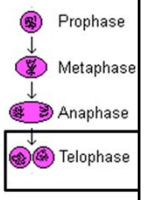
Two spindles are visible, both are darker in color than the surrounding nuclei. The formation of two individual cells are visible, but the cells are not separated fully yet.

Sarcoma slide 1: Ref:

http://www.wellcome.ac.uk/Education-resources/Teaching-and-education/Big-Picture/All-issues/The-Cell/Image-galleries-Aspects-of-imaging/WTDV030896.htm

Telophase





Two spindles are visible, both are darker in color than the surrounding nuclei. The formation of two individual cells are visible, but the cells are not separated fully yet.

Sarcoma slide 1: Ref:

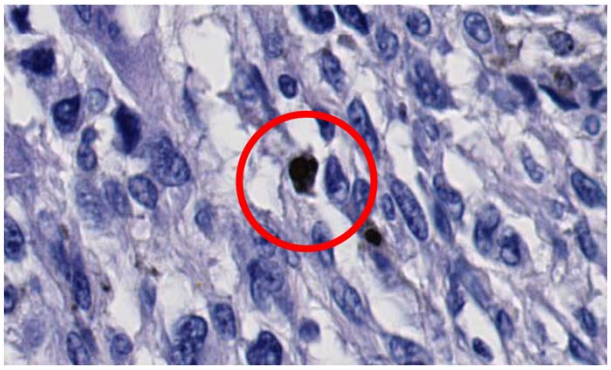
http://www.wellcome.ac.uk/Education-resources/Teaching-and-education/Big-Picture/All-issues/The-Cell/Image-galleries-Aspects-of-imaging/WTDV030896.htm

False Positives

- Not all strongly stained cells are Mitotic Figures
- There maybe staining artifacts and other cells which should not be counted as Mitotic Figures
- Please review the following examples which are not Mitotic Figures

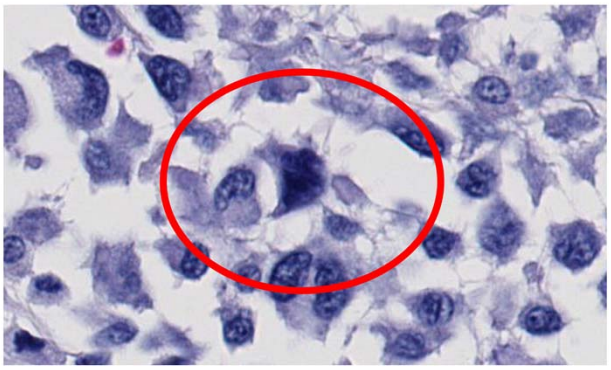
False Positives

False Positives

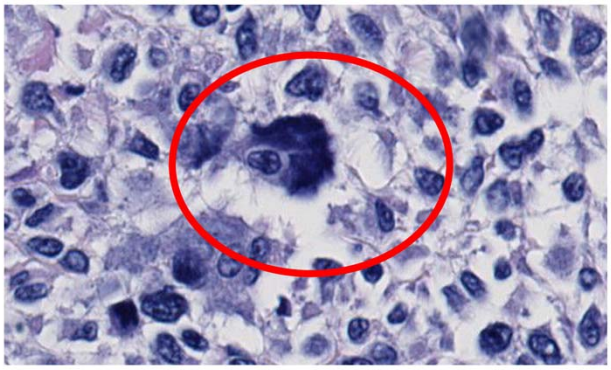


False Positives

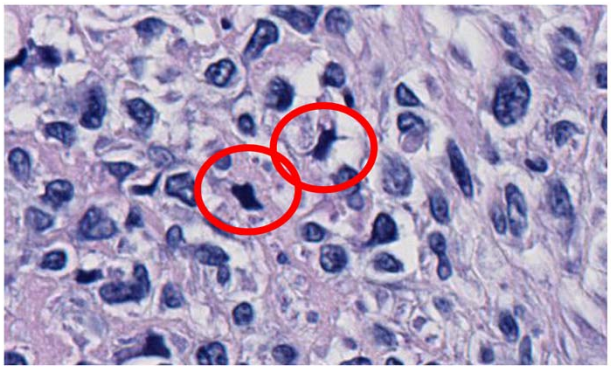
False Positives



False Positives



False Positives



False Positives