Mitosis

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Data Collection

Table with 100 cells recorded in an onion root tip to show which stage of mitosis each cell is in

Cell Phase	**Number of cells (± 5 cells) ***
Interphase (phase before mitosis)	43
Prophase	20
Metaphase	12
Anaphase	10
Telophase	15

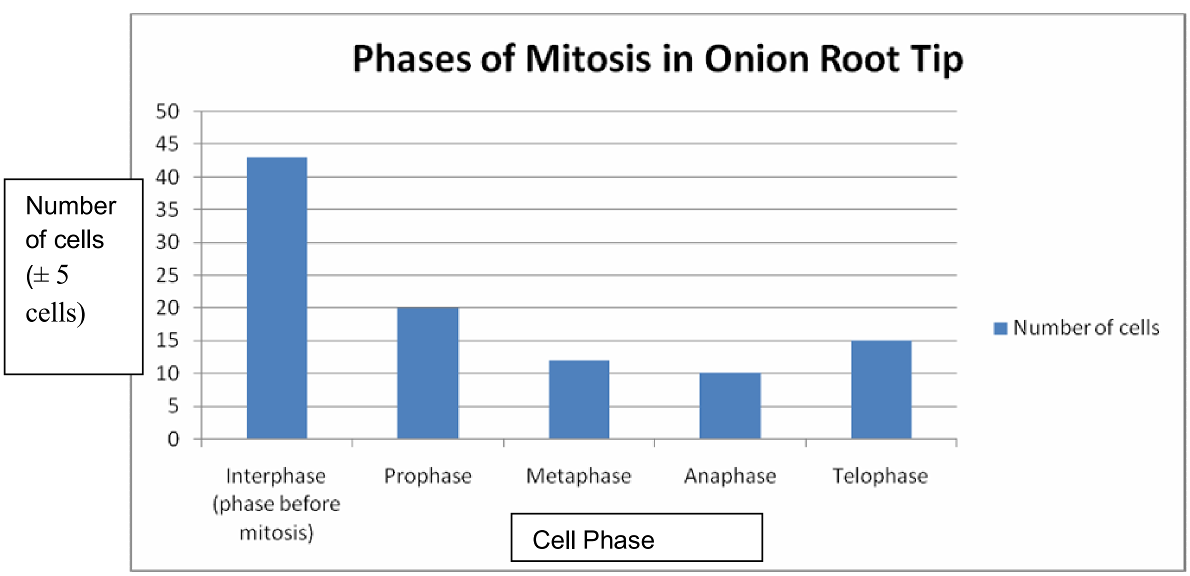
Table with 100 cells recorded in a different onion root tip region to show which stage of mitosis each cell is in

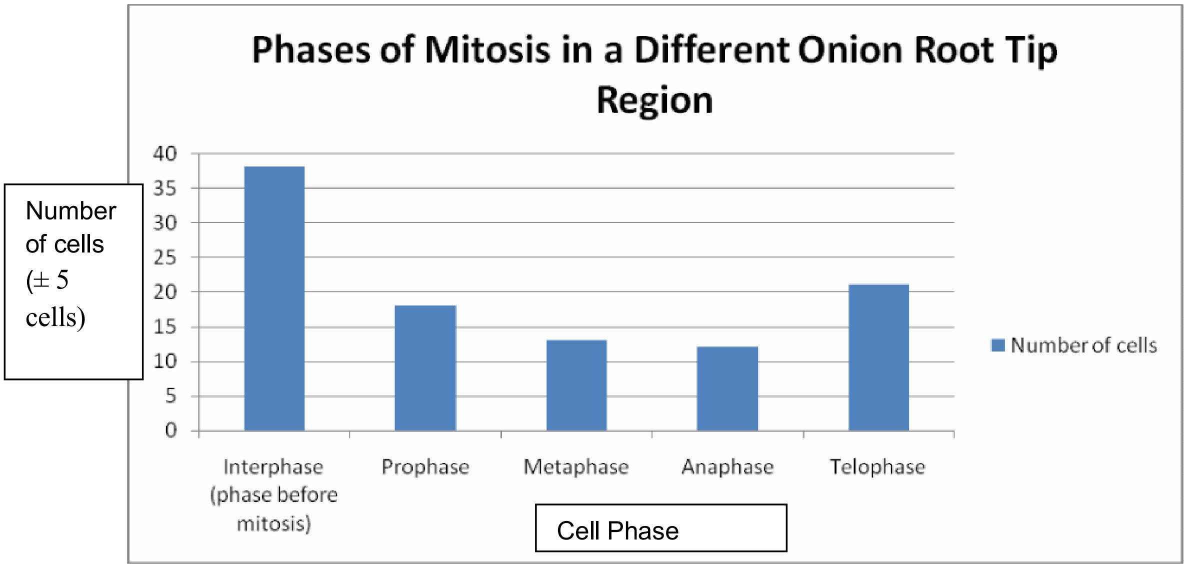
Cell Phase	**Number of cells (± 5 cells) ***
Interphase (phase before mitosis)	36
Prophase	18
Metaphase	13
Anaphase	12
Telophase	21

*These uncertainties are an estimated non-systematic (human) error during the practical.

Data Processing

Graphs





= ± 5 Cell Error Margin

Objectives:

1. *Describe the events occurring in each stage of mitosis emphasizing the movement of chromosomes.*

   Prophase: This phase is the first phase in mitosis. In prophase, chromatids formed from interphase are starting to be shown as chromosomes, since they are shortening and thickening, making them more visible to a microscope. Each chromosome contains two sister chromatids, joined together by a centromere. The nuclear membrane of the nucleus starts to disappear, and so does the nucleolus. Centrioles in the cell start to move to either end of the cell, and they stay put at the ends. The centrioles start to produce mitotic spindles, which are extending across the cell.

   Metaphase: The nuclear membrane is fully disappeared, and the mitotic spindles are rapidly extending across the cell. The spindles are then attached to the kinetochore of each chromosome, and the spindles align the chromosomes in the middle of the cell. They are aligned in the middle so that when separated in anaphase, the nucleus from the two daughter cells will get a copy from each chromosome.

Anaphase: The chromosomes separate from the kinetochore, and so one chromatin from the chromosome goes to one side, and the other chromatin gets pulled to the other side. These chromatids are then known as chromosomes when separate. In anaphase, the chromatids are not at the sides yet, but rather just separated and heading towards the sides.

Telophase: The chromatids have reached each side of the cell, and then the whole cell starts to split. During this phase, the copy chromatids on either side are then wrapped in a new nuclear membrane, and each side is referred to as a new daughter cell, with the chromatids now called chromosomes. The chromosomes started to become thinner and longer, so they become invisible to a microscope. In telophase, it is important to be aware that both daughter cells have the same number of chromosomes that the original cell had. In telophase, the original cell does not split fully, and so the daughter cells are still forming to near completion.

2. *Identify the stages in the cell cycle and the time the cell spends in each stage.*

Interphase : The cell spends 39.5% * of its time in interphase. Interphase consists of 3 periods of time. G1 (Gap 1), where the cell is just growing and carrying out its normal specific functions and activity. S (synthesis) is a period where the cell's DNA is replicating. G2 (Gap 2) is when the cell goes back to growing and carrying out its functions and activity.

*((79/200)*100) ----- 79 represents the total number of cells (Both cell division regional interphase cells added together (43+36)) out of 200 in interphase. Dividing that number by 200 (Total number of cells recorded), and multiplying it by 100 should give the total percentage time in interphase.

Mitosis: This is when the cell is diving, and the cell spends 60.5 % * of its time in mitosis. Mitosis consists of prophase (19%)* , metaphase (12.5%)*, anaphase (11%)* and telophase (18%)*.

*((Specific phase total/200) * 100) ----- Diving the number of cells in the specific phase (specific phase cells in both regions added together) by the total number of cells, which is 200, and then multiplying everything by 100 to give the specific cell percentage time in that phase.

* ((121/200) * 100) ----- 121 represents every phase total cell count (total cell count for each phase equals root tip cells in specific phase + area above root tip cells in specific phase) added together. Then, that number divided by 200 (Total root tip cells + total area above root tip cells), and then multiplying everything by 100 to give the specific cell percentage time in mitosis.

Cytokinesis: This is when the cell actually splits into its daughter cells. The cell spends 0% (no cells shown to be in cytokinesis) of its time in cytokinesis.

The literature value for each phase in an onion cell (in the root tip) states that 90% of the time, the cell is spent in interphase. So 10% of the time, the cell is actually dividing (Mitosis + cytokinesis). The mitosis consists of prophase (5%), metaphase (2%), anaphase (0.5%), and telophase (2%). The left over 1% is the cytokinesis.

3. *Describe and compare the structure of a late prophase chromosome with an anaphase chromosome.*

Late Prophase Chromosome	**Anaphase Chromosome**
Diagram	Diagram
Description A late prophase chromosome consists of two identical sister chromatids. These chromatids are connected together by a centromere, which can be located anywhere in-between the chromosome.	Description An anaphase chromosome is a single chromatid, which is then called a chromosome. The chromatid has no centromere, since it does not have another chromatid to connect to.

Comparison

In both structures, the chromatids carry the same amount of DNA as each other, which is a major similarity. However, even though the late prophase chromosome is called a chromosome, it contains two chromatids, while the anaphase chromosome contains only one chromatid. So a late prophase chromosome has double the amount of DNA. In the late prophase chromosome, the centromere is still visible and connects the two sister chromatids together. In an anaphase chromosome, the kinetochore starts to disappear, because there's only one chromatid.

Conclusion:

In the onion root tip, out of 100 c ells, 43 were in interphase, 20 in prophase, 12 in metaphase, 10 anaphase, and 15 in telophase. This shows that in the root tip of the onion, the majority of cells are in the phases of mitosis (57% in total).

In the different region of cell division, out of 100 cells, 36 cells were in interphase, 18 cells in prophase, 13 in metaphase, 12 in anaphase, and 21 in telophase.

In total (root tip + different region root tip), out of 200 cells, 79 were in interphase (39.5%) and 121 cells were in the phases of mitosis (60.5%). This shows that in total, most of the cells are in mitosis.

None of the cells seemed to be in a final stage of cytokinesis.

Evaluation:

From both regions of the root tip, it is fair to say that the cells are constantly dividing. This is because the root tip wants to push into the ground, and can only do this by cell division. The rest of the time, the cell is in interphase (39.5%) carrying out its regular activities, such as preparing for mitosis, growing, and providing the onion with the necessary functions in order for the cell to survive.

There was a major uncertainty that could have possible affected the results. The uncertainty was one made by us, which was ±5 cells. So when counting, it could have been that some cells were counted twice, or that a few cells were missed during the count. This leaves a big error margin, and could have possible affected the outcome of the results. Also, sometimes it was unclear if there were 2 cells or 3 mashed together, which also contributes to the uncertainty and potentially less accurate results.

The literature value found (stated in data processing) shows that our results are not valid within the given error margin.

In the second root tip region, it was hard to count 100 cells in that specific area, and so the onion slide had to be moved around a little to record more cells. This could have potentially led to less accurate results because doing this ruins the idea of picking one exact spot above the root tip and recording the number of cells.

The number of cells used to record could have been an insufficient amount, contributing to less valid results.

However, when recording the cells, none of them seemed to be in cytokinesis, which means that the root tip regions was not yet developed on pushing the root down. It could also mean that the root tip regions was not a good choice for showing cytokinesis, but rather the process (mitosis) leading up to it. A third possibility could have been counting more cells, however, it is a small probability that a cytokinesis cell is recorded, because it is hard to distinguish between an interphase cell or a newly formed daughter cell from cytokinesis. Cytokinesis is just the final split, and to record that is difficult.

Improving the investigation:
Firstly, it is important to reduce the error made by the person recording the cells. It is essential to put more care into recording, and to count with more care and accuracy, rather than speeding the experiment. This can already contribute to much more accurate results.

Another improvement would be to repeat the experiment two or three times, which would increase the precision of the experiment. If the experiment is repeated three times, an average of the three set of results could be taken, making the results more precise.

Increasing the number of cells to record would also be helpful to improving the investigation, because that would leave to more accurate results. If a sample of 400 cells was recorded, then the uncertainty of ±5 cells would be less effective. Reducing the uncertainty always causes results to be more accurate.