An experimental study on plant and animal cell structure

Aim

The aim of this experiment is to study the ultrastructure of plant and animal cells and see the way they differ between each-other.

Introduction

Cells are microscopic building blocks of unicellular and multicellular living organisms. Animal, plant, fungal and bacterial cells are different in terms of structure but also have many similarities. An example is the fact that plant cells can contain chloroplasts while animal cells do not. In this experiment only plant and animal cells will be analysed. Cells are microscopic so to see their structure we need to use microscopes. Not all the structures are always clearly visible from the microscope. We can see more structures clearly if we use stains to colour specimens before putting them under the microscope. Stains are coloured dyes that are absorbed by some cell structures but not by others. An example of a stain which is used is iodine solution.

Educated guess

With a light microscope it is possible to identify all the ultrastructure and differences between cells of different type

Variables

Dependent variables	Independent variables	Controlled variables
Visibility of cell structures	Magnification	Quantity of Lugol
Clarity of the image	Focus of microscope	Thickness of slice (0 to 0.2 mm)

Materials

- Onion —> made of eukaryotic plant cells
- Iris —> made of eukaryotic plant cells
- Saliva —> made of eukaryotic animal cells
- Lugol —> iodine solution to see the cell better
- Forceps —> handle the slice of material without touching it
- Scalpel —> to cut slices of materials
- Phone camera —> report what seen
- Microscope —> equipment to analyse cells with magnification
- Pipette —> put iodine solution with more precision
- Slide —> for onion / saliva / iris
- Cover slip —> to keep cells pressed flat and to shape the iodine solution flat
- Denatured alcohol —> for safety precautions
- Cotton —> for safety precautions
- Napkin —> for material disposal
- Plastic spoon —> to scratch inside of cheek
- Methylene blue —> to see the cell in a better way

Method for onion / iris plant cells

Firstly turn on the microscope by connecting the plug to the socket. Cut a slice of onion / iris thinner as possible (cells are more visible in this way) helping your self with the forceps. Move the cut slice of material onto a clean slide. Afterwards, using the pipette, take enough Lugol to be able to then pour precisely a drop on top of the onion / iris slice. Consequently pick up the cover slip and position it on top of the slide. Press it gently in the way to flatten the onion / iris slice, and to shape the iodine solution around in an homogeneous manner. Properly place the whole thing on the slide holder of the microscope and turn on the light to be able to see the cells. Adjust the intensity of the light to be able to see the cell structure as efficiently as possible. Try and observe the tissues with all four magnifications available on a simple light microscope (4 x; 10 x; 40 x; 60 x). Report what seen with the phone camera and note down the structures visible / recognisable of the cell.

Method for cheek animal cell

Firstly turn on the microscope by connecting the plug to the socket and light up the lamp to a level enough bright to be able afterwards to see the cells. Scratch the inside of your cheek with the plastic spoon. Put the cells obtained from scratching on a slide. Afterwards pour one drop of methylene blue on the slide with the cells to see the structure more precisely and wait 2 minutes for the methylene blue to be absorbed by the cells. Using the pipette, carefully wash out the methylene blue in excess. Consequently pick up the cover slip and position it on top of the slide. Press it gently in the way to flatten the cheek cells and the methylene blue homogeneously. Adjust the intensity of the light to be able to see the cell structure as efficiently as possible. Try and observe the animal cells with all four magnifications available on a simple light microscope (4 x; 10 x; 40 x; 60 x) and report all seen with the camera. Looking at the pictures taken analyse what structures of the cells can be seen.

Results

- plant cell drawing compared to onion cell at 60 x

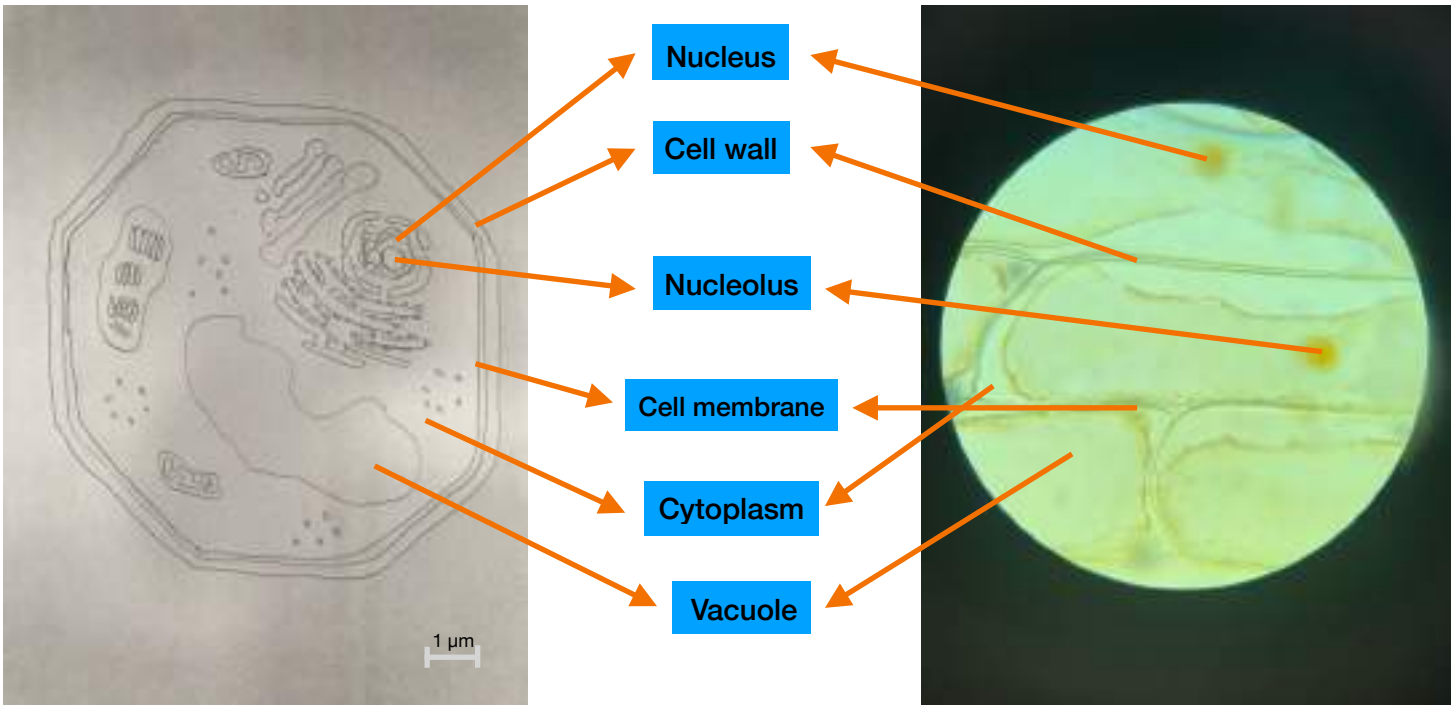

Figure 1 —> drawing of ultrastructure of plant cells

Figure 2 —> picture of onion cells 60 x

- plant cell drawing compared to iris cell at 10 x

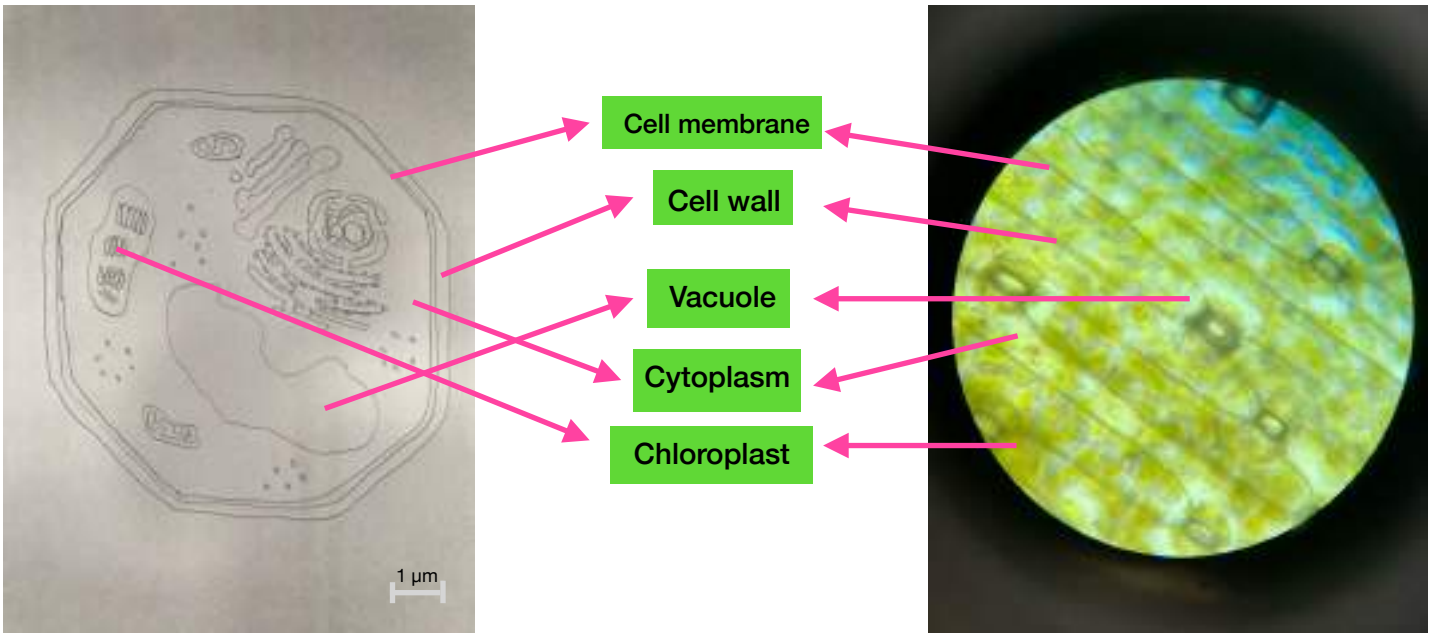

Figure 3 —> drawing of ultrastructure of plant cells

Figure 4 —> picture of iris cells 10 x

- animal cell drawing compared to saliva cell at 40 x

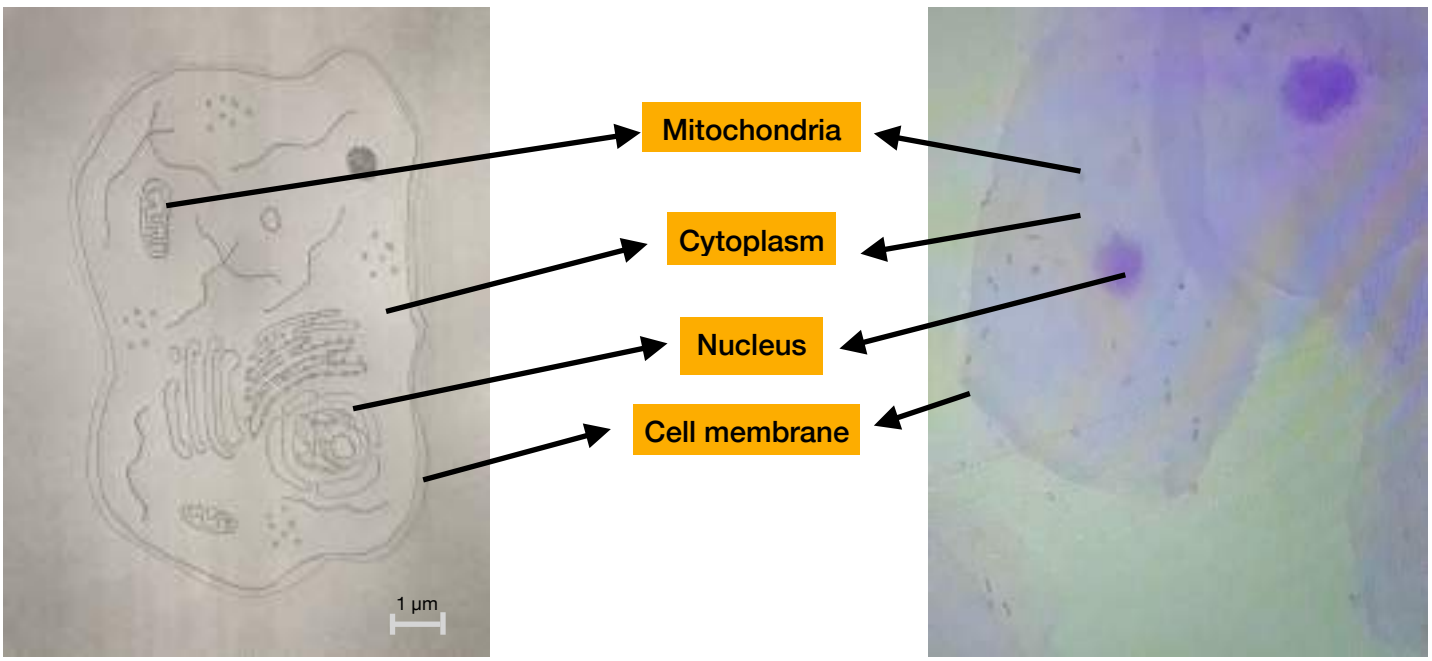

Figure 5 —> drawing of ultrastructure of animal cells

Figure 6 —> picture of cheek cells 40 x

Table

	Onion plant cell	Iris plant cell	Cheek animal cell
Visible structures	Nucleus; Nucleolus; Cell wall; Cell membrane; Vacuole; Cytoplasm;	Nucleus; Cell wall; Cell membrane; Vacuole; Cytoplasm; Chloroplast;	Nucleus; Cytoplasm; Cell membrane; Mitochondria;
Non-visible structures	Mitochondria; free ribosomes; chloroplast; rER; sER;	Mitochondria; free ribosomes; rER; sER; Nucleolus; Nucleolus;	Cytoskeleton; Nucleolus; Mitochondria; free ribosomes; lysosome; peryxosome; rER; sER;
Percentage of structures recognised	6 / 12 —> 50 %	5 / 12 —> 42 %	4 / 12 —> 33 %

Discussion

From the photos we can state that the educated guess was partially correct as not all structures of the cell could be identified. We can deduce this by comparing the drawing containing all the organelles present in the different cell types with the real image of the cell. By doing so, many parts of the ultrastructure are not recognisable as the resolution is not adequate and the image of the cell is not enough magnified to be able to see the different parts sharply.
In the onion cell the structures identified were the nucleus, the nucleolus, the cell membrane, the cell wall, the vacuole and the cytoplasm. Instead in the iris plant cell were the chloroplast, the vacuole, the cell wall and the cell membrane. At last instead in the cheek cells dozens of ribosomes, the nucleus, the cell membrane and the cytoplasm were distinguished.
We can also see from the pictures that both the iodine solution and the methylene blue had the effect wanted on the cells, in fact the structures visible were easily identifiable.
The layers of an onion contain simple sugars (carbohydrates) some of which are stored as starch. Given that iodine tends to bind to starch, it stains the starch granules when the two come in to contact making them visible. Even though onion are plants, no chloroplast were visible for the fact that the chloroplast necessary for photosynthesis are largely present in the leafy part of the onion, which is exposed to the sun and absent in the bulb which is below ground and away from sunlight.
Instead human cheek cells can be observed under a microscope after staining with methylene blue dye. Since methylene blue (cationic in nature) binds with DNA and RNA (anionic in nature) by electrostatic means, it gives a darker color to nucleic materials.

Conclusion

The images collected and analysed in the results did not fully confirm the educated guess which stated that with a light microscope it was possible to identify all the ultrastructure and differences between cells of different type. Only some of the organelles present in the animal and plant cells were recognisable while the other parts were not enough big in size to be able to acknowledge their presence with the light microscope used.

Evaluation

Overall the experiment's results found were not to take in consideration as examples to classify the elements of the ultrastructure as the label was done on a theoretical basis. This means that some organelles of the cell could have been labelled mistakenly. To improve the reliability of the results, the experiment should be conduced analysing more than one cell per type to be able to notice some aspects that may have not been visible in the previous cells. The other important aspect that would increase the validity of the results is labelling all cells at 60 x. If well focused, the microscope is able to magnify the image at dimensions that would profit the recognition of the ultrastructure of the cells.

References

- https://www.bbc.co.uk/bitesize/guides/zyhrng8/revision/1
- https://microcosmos.foldscope.com/?p=98800