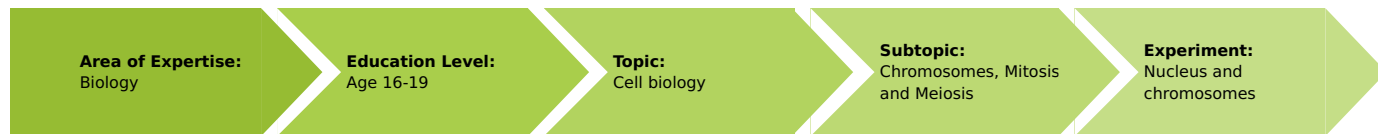


# Nucleus and chromosomes (Item No.: P1441401)

## Curricular Relevance



### Difficulty



Easy

### Preparation Time



10 Minutes

### Execution Time



30 Minutes

### Recommended Group Size



1 Student

### Additional Requirements:

- Onion
- Absorbent paper

### Experiment Variations:

### Keywords:

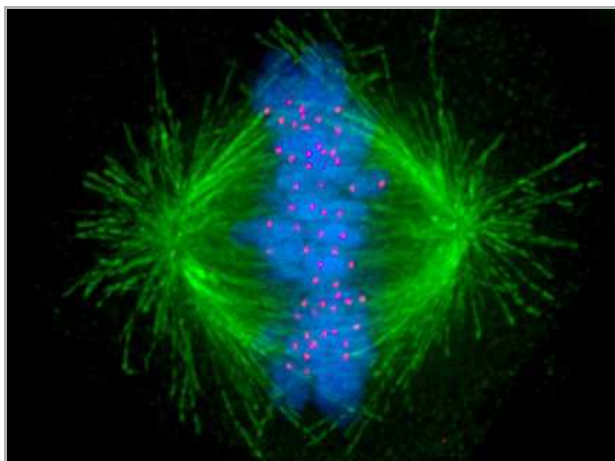
Mitosis, Division of the cell nucleus, Nucleus, Chromosomes

## Information for teachers

### Introduction

#### Application

The principle of mitosis is used in research for finding cures for cancer.



Metaphase of mitosis



Experiment set-up

#### Educational objective

Cell proliferation is based on the principle of cell division. Mitosis itself solely describes the division of a cell nucleus and not the division of cells as a whole.

#### Task

During this experiment, the students have to view plant cells with a microscope during mitosis.

#### Prior knowledge

The students should be familiar with microscopes and the preparation process. In addition, mitosis should be discussed in a theoretical form prior to the experiment.

#### Information on mitosis

Mitosis is extensively dealt with in biology textbooks. The information given on the students' worksheet is intended as a first approach to the experiment, however, it is not sufficient for preparation. For example, the reduplication of the number of chromosomes is not explained. The students should therefore have been made familiar with the subject in class and have already seen corresponding illustrations. Films featuring the processes of mitosis are also available for teaching this subject in class, e.g. on YouTube.

Some mitotic stages are only recognizable with good preparation.

## Notes concerning the set-up and execution of the experiment

### Information on obtaining materials

Tissue undergoing growth processes (meristems) is required for this experiment. It is encountered in all root tips. If vegetable onions are used as described in the students' worksheet, a preliminary test must be performed to find out whether these roots really do grow. Some onions sold at supermarkets have been treated with agents suppressing germination. Onion sets from a gardener's shop are surely a better choice. Tulips, daffodils, and hyacinth onions are also suitable. Alternatively, seedlings of various plant species can be cultivated on moist absorbent paper (garden cress, mustard, garden beans) and their roots prepared accordingly.

A special hyacinth glass, an egg-cup, or an Erlenmeyer flask can be used to grow the roots. The onion's root growth can also be initiated up to 14 days before microscopy. The removal of the root tips should proceed in the early morning hours. Should this not be possible, the tips may also be cut off and fixated by the teacher (fixation solution: mixture of 96% ethanol and 99% acetic acid, 1:3).

### Preparation of slides

Repeated tests performed beforehand by the teacher are recommended. The students must work with great care, so that it is reasonable that a thorough discussion should precede the experiment. The boiling step should be done over the lowest possible flame. Liquid is usually lost in the course of boiling or crushing, wherefore some carmine acetic acid or vinegar may be added, if necessary. The crushing technique should be demonstrated: when crushing, lateral pressure should be avoided, absorbent paper should be placed on top of the cover slip, pressure exerted evenly and vertically downwards. The cover slip will then remain intact.

### Microscopy

One should not have too high expectations. The students might at least recognize the stained chromosomes. If they scan their slides carefully, they will discover various cell division stages. If the mounted specimen is too thick, or should there be no stages of cell division to be found on them, the experiment should be repeated. Hence a sufficient number of onion roots must be made available.

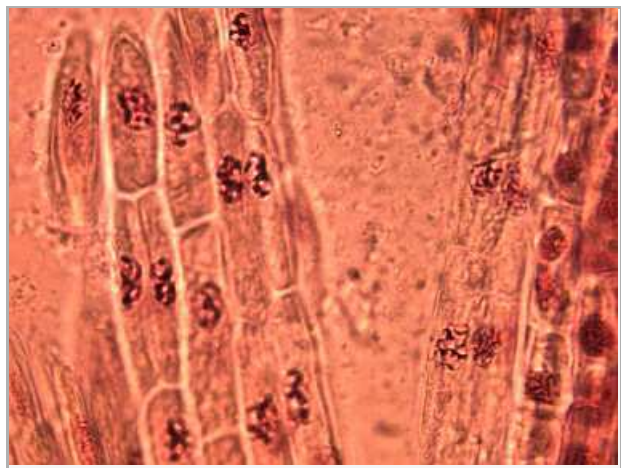
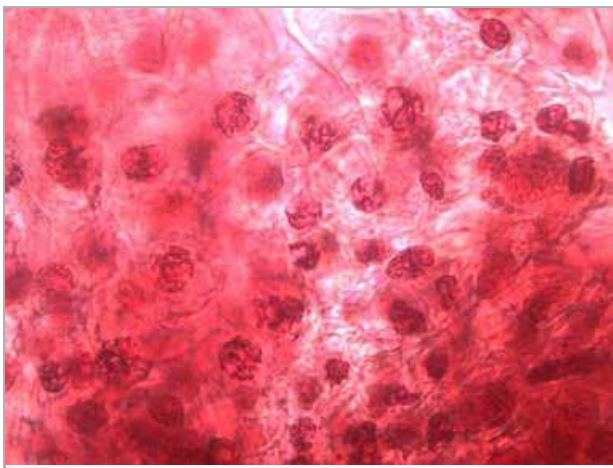
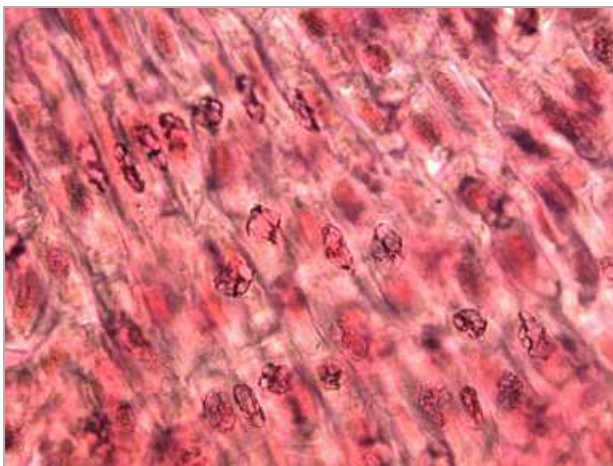
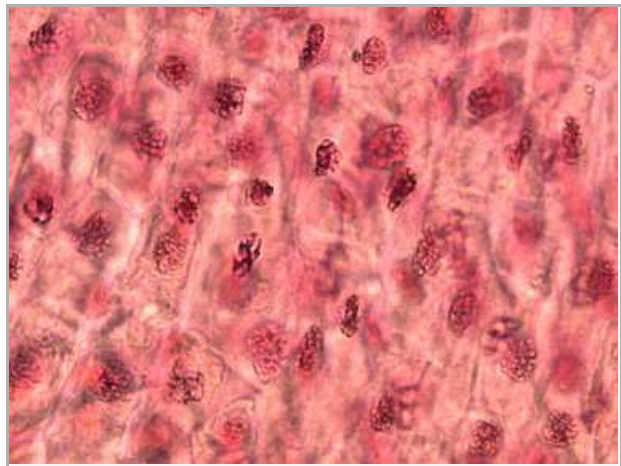
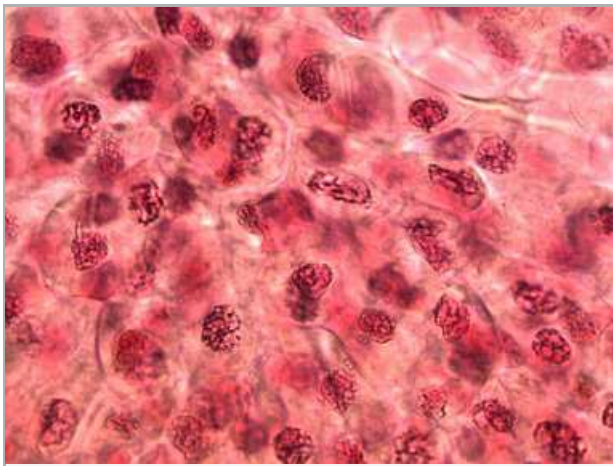
### Evaluation

The intention pursued with the drawing and commentary consists in learning systematic observation and making comparisons with graphical representations in textbooks.

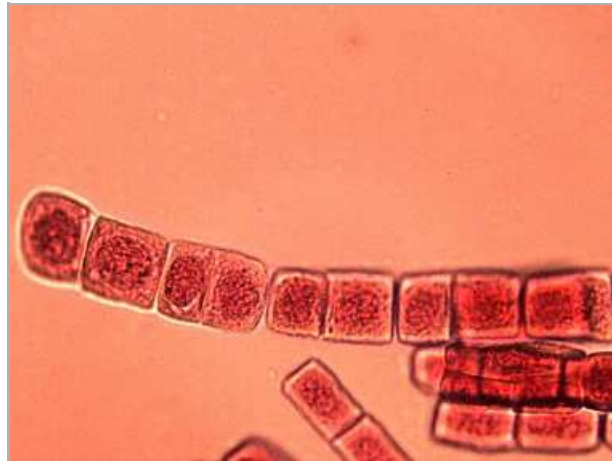
## Principle

The nucleus is recognizable under the light microscope as a circular object. It can be seen even without previous staining. The nucleus is the control center of many cellular processes and harbors the hereditary information. The nucleus contains filamentous structures (chromatin) which after staining appear as a homogenous mass.

Cell division always commences with a division of the nucleus (mitosis). In preparation to this division, the filaments retract and become shorter and thicker. Staining now makes distinctive objects visible, i.e. the chromosomes. The genetic information they contain has already undergone reduplication. The membrane that envelopes the nucleus dissolves, the chromosomes gather in the center of the cell. Attached to the spindle apparatus they migrate to the poles of the cell, where they form two new nuclei. Only then does the body of the cell divide and thus two daughter cells are created.



*Allium cepa* (400x) stained with carmine acetic acid



Cress (400x)

## Equipment

Position No.	Material	Order No.	Quantity
1	Euromex BioBlue BB.4250 microscope	EUR-BB-4250	1
2	Microscopic slides, 50 pcs	64691-00	1
3	Cover glasses 18x18 mm, 50 pcs.	64685-00	1
4	Scissors, straight, pointed, l 110mm	64623-00	1
5	Dropping pipette with bulb, 10pcs	47131-01	1
6	Tweezers, straight, pointed, 120mm	64607-00	1
7	Scalpel holder	64615-00	1
8	Scalpel blades, rounded tip, 10 off	64615-02	1
9	Test tube holder, up to d 22mm	38823-00	1
10	Carmine acetic acid sol. 250 ml	31469-25	1
11	Bunsen burner, natural gas, DIN	46917-05	1
12	Safety gas tubing, DVGW, sold by metre	39281-10	1
13	Hose clip, diam. 8-16 mm, 1 pc.	40996-02	2
14	Erlenmeyer wide neck, boro., 250ml	46152-00	1



## Safety information



### Hazard and precautionary statements

Carmine acetic acid:

H314	Causes severe skin burns and eye damage.
P280	Wear protective gloves/protective clothing/eye protection/face protection.
P260	Do not breathe vapour.
P301 + P330 + P331	IF SWALLOWED: rinse mouth. Do NOT induce vomiting.
P302 + P352	IF ON SKIN: Wash with plenty of soap and water.
P305 + P351 + P338	IF IN EYES: Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
P309 + P310	IF exposed or if you feel unwell: Immediately call a POISON CENTER or doctor/physician.

### Hazards

- Carmine acetic acid is highly corrosive!
- Put on protective glasses!

# Nucleus and chromosomes (Item No.: P1441401)

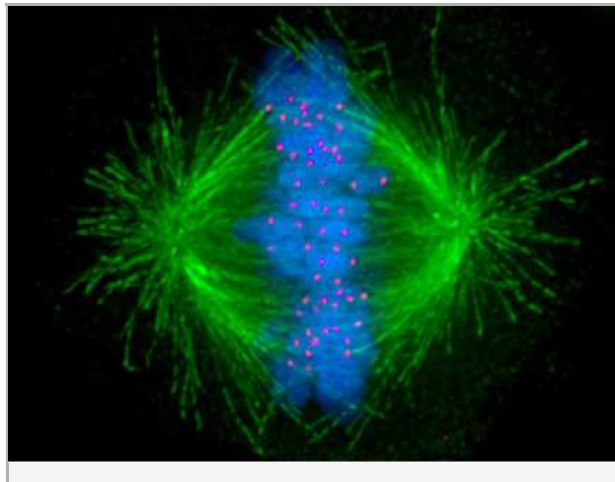
## Introduction

## Application and task

### How does the cell proliferation work?

#### Application

The principle of mitosis is used in research for finding cures for cancer.



#### Task

Study plant cells undergoing mitosis under the microscope.



## Equipment

Position No.	Material	Order No.	Quantity
1	Euromex BioBlue BB.4250 microscope	EUR-BB-4250	1
2	Microscopic slides, 50 pcs	64691-00	1
3	Cover glasses 18x18 mm, 50 pcs.	64685-00	1
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14	Erlenmeyer wide neck, boro., 250ml	46152-00	1

## Set-up and procedure

### Set-up

#### Hazards

- Carmine acetic acid is highly corrosive!
- Put on protective glasses!



#### 1. Theoretical preparation

Gather information about the stages of mitosis.

Look at the graphical representation of the individual division stages.

#### 2. Practical preparation

The processes of cell division particularly occur in tissues undergoing rapid growth (meristems). Such proliferating tissue is found in the tips of roots.

A bulb of the common onion is placed on a glass, so that the onion's disc is just slightly above the surface of the water.

Roots will form after a period of three to seven days. Their tips can be used for preparing the microscopic slides.

The best daytime to carry out the following preparation steps is the early morning, since this is the time when most cell divisions take place.



Fig. 1

## Procedure

#### 3. Preparation of the slide

Cut off 3 mm of the root with the scissors and cut the root in half with a scalpel (Fig. 2 and Fig. 3).



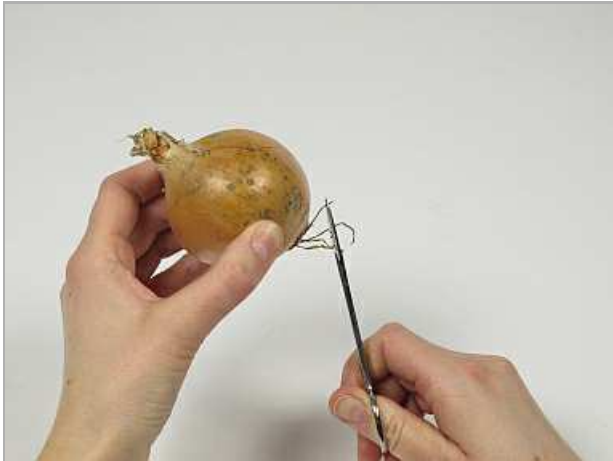


Fig. 2



Fig. 3

One drop of carmine acetic acid is pipetted on the slide (Fig. 4).

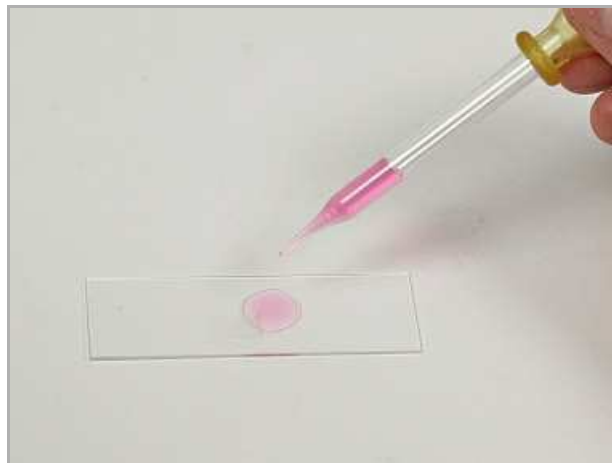


Fig. 4

The root piece is placed directly into the carmine acetic acid and covered with a cover slip (Fig. 5).



Fig. 5

The mount should now be gently heated until it softens but still remains intact. After boiling, a crush preparation will be made. This is how: The slide is carefully swayed over the flame of the burner until small bubbles emerge (Fig. 6).



Fig. 6

The slide is set on a level surface, covered with absorbent paper, and the root piece is crushed by pressing the cover slip down with your thumbs (Fig. 7). This produces a thin and transparent mount. Take care not to damage the cover slip. If necessary, apply a drop of liquid next to the cover slip so that the specimen will become moist again. Since not every preparation will turn out successful, it is recommended to make several parallel preparations.

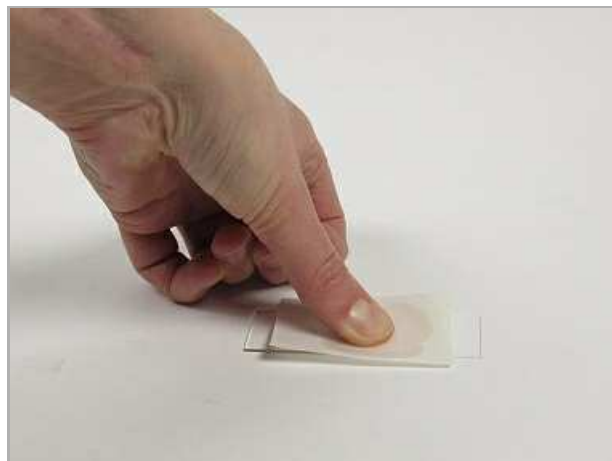


Fig. 7

## 4. Microscopy

Study the specimen under the microscope with the highest power.

Search for cells in which chromosomes can be seen.

Try to assign the arrangement of chromosomes to the stages of cell division known to you from theoretical preparation.

## Report: Nucleus and chromosomes

### Result - Sketch

Draw two cells in which you recognize cell division processes.

### Result - Question 1

Write a short commentary with an explanation of these cells.

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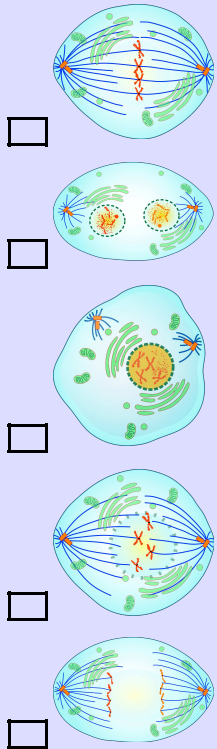
## Evaluation - Question 1

Which of the following statements are true in terms of mitosis?

- ☐ Mitosis is the division of the cell nucleus.
- ☐ Mitosis is the division of a cell.
- ☐ The number of chromosomes doubles during mitosis.
- ☐ Mitosis is divided into 4 to 5 phases.

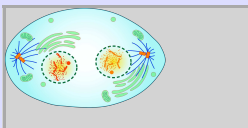
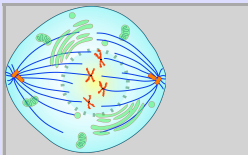
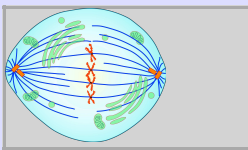
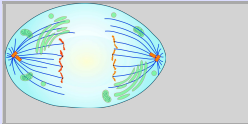
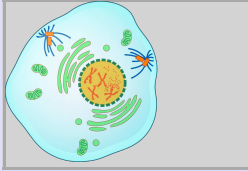
## Evaluation - Question 2

Put the individual phases of mitosis into the correct chronological order.



## Evaluation - Question 3

Assign the pictures of the various phases of mitosis to the correct terms.



Prophase

Prometaphase

Metaphase

Anaphase

Telophase

## Evaluation - Question 4

How many pairs of chromosomes do humans have?