

2024

CELL-ebration: a microscopic adventure!

TEACHER'S MANUAL

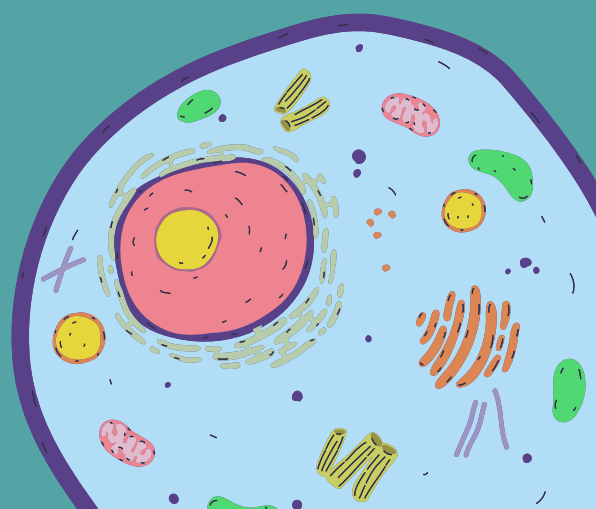
Subject:
Cell Biology



By
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Course overview

In this section, I will briefly describe what this course is, its learning objectives, target group, success criteria, international competences and differentiation that is incorporated.

Description of the course

This teacher's manual accompanies the course 'CELL-ebriation: a microscopic adventure!'. This course was designed as a flipped classroom course in which the lecture and readings happen at home and active classroom activities are planned during classroom time. Various other teaching strategies and educational theories have been incorporated in this course which has been discussed in the previous section.

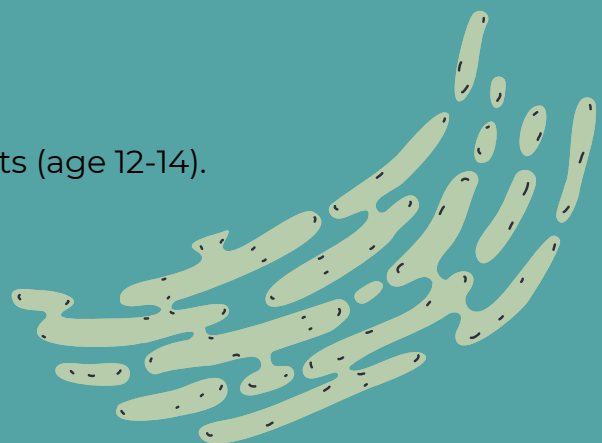
In this course, students will learn about cells, the differences between animal and plant cells, and cell division. On the online environment, the students can explore the content in form of a story. Various videos, texts, and online tools are provided for the students to absorb the new contents and check their understanding. During classroom time, student-centred activities and practicals are planned to solidify the students' understanding of the content.

Learning objectives

Throughout this course students will learn several skills. At the end of this course students will be able to **state** the differences between animal and plant cells, **identify** the cell organelles and **connect** them to their functions, and **explain** and **model** cell division.

Target group

The target group for this course are MYP2 students (age 12-14).



Success criteria

The success criteria are the following:

- Complete the homework/online activities and come to class with the new learned knowledge
- Participate in the classroom activities
- Build a 3D model of a cell and hand it in together with an agenda explaining the different parts of the cell

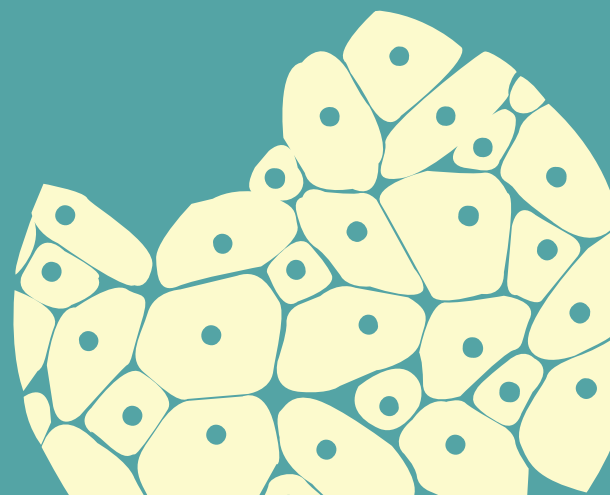
Differentiation

In this course, differentiation was included in various ways. The content is always delivered in multiple ways; text, video, pictures, flashcards, etc. and students are usually given the choice to choose at least one of them. In some cases, there are two types of videos provided from which the students can choose one (e.g. the mitosis song is available as rap version and another version). For students that enjoy learning through games there are games included but also some more challenging quizzes or fill in the blanks activities. For the fill in the blanks activity on the page 'animal cells and plant cells', the missing words are mentioned underneath the activity to aid students that are struggling. At the end of each online page, there is an opportunity to have a look at the materials for the upcoming classroom activities for students who would like to prepare more or are just curious to see what will be done.

International competences

Throughout this course, students will be improving the following competencies and skills:

- Knowledge of communication styles
- Engagement with other people
- Listening, observation, and interpretation skills
- creativity



Classroom activities

Following after the online self-study sessions, there will be 3 classroom activities which will be happening within 3 lessons of 100 minutes. The activities are supposed to help students solidify their understanding of the new topics. Therefore, the lessons will be student-centred. The classroom activities will be the following:

- 1)Cell-Bingo
- 2)Looking at onion skin and cheek cells under the microscope
- 3)Building a 3D model of a cell
- 4)Modelling mitosis

Lesson 1

There is no classroom activity planned after the introduction part of the online learning environment, but students are supposed to have a look at it before going through the section 'cell organelles and their functions'. In this section, students learn about the different cell organelles, what they look like, and their specific functions within a cell. In the first **30 minutes** of the following lesson, you will play "**Cell-Bingo**" with the students.

Explanation of the activity: You have printed out the bingo sheets and the definitions of cell organelles. Every student will receive a bingo sheet. Then you read out the definitions and when a student has the word that matches the definition, they can make a cross through it. If a student has 3 crosses next to each other they have a bingo and optionally they can get a price for this.

Cell-Bingo activity.

Duration: 30minutes

Explanation:

1. Every student will receive a bingo card.
2. The teacher will call out definitions of the cell organelles.
3. The students have to make a cross through one of the bingo boxes if the definition matches the word on their card.
4. If a student has three crosses next to each other (vertically, horizontally, or diagonally) they have a bingo.
5. Students who have a bingo can come forward and collect a candy (optional).

Resources:

-Variation of bingo cards

Mitochondria	Nucleus	Golgi Apparatus
Cytoplasm	Vacuole	Lysosome
Centrosome	A cell	chloroplast

Cell-Bingo

Mitochondria	Cell membrane	Nucleus
Centrosome	Cell wall	Lysosome
Golgi Apparatus	Ribosome	Endoplasmic reticulum

Cell-Bingo

Endoplasmic reticulum	Nucleus	Mitochondria
Cell call	Chloroplast	Vacuole
Golgi Apparatus	A cell	Ribosome

Cell-Bingo

Vacuole	Cytoplasm	Golgi Apparatus
Cell membrane	A cell	Lysosome
Ribosome	Mitochondria	Cell wall

Centrosome	Helps during cell division
Chloroplast	Makes energy from sunlight
Nucleus	Contains the genetic information and is the control centre of the cell
Endoplasmic reticulum	Network through which proteins can move
Cell wall	Supports and protects the cell
Mitochondria	Makes energy
Ribosome	Makes proteins
Cytoplasm	Chemical reactions happen within it
Lysosome	Breaks down materials
Cell membrane	Transports nutrients in and out of the cell
Golgi apparatus	Packages and delivers important molecules
Vacuole	Stores water and manages waste
A cell	Basic building block of all living organisms

After the “Cell-Bingo” the other **70 minutes** of the lessons will be used to do a **microscope activity**. Students get to dig into the microscopic world and have a look at onion skin cell and cheek cells.

Explanation of the activity: Have the lab sheet printed out for the students. You should put students in pairs and make them read the lab sheets before starting the lab. There is a list of materials. You should have these materials laying ready either on the students’ desks or in the front of the classroom where the students can get them. On the lab sheet the procedure is explained step by step. Students should be able to complete the lab independently by following these instructions. However, if students need support or assistance you should be ready to help.



Looking at onion cells and cheek cells under the microscope

In this lab, we will be looking at onion cells (plant cells) and cheek cells (animal cells) under the microscope. Can you identify any differences?

You will be working in pairs!

Objective: Observe the structure of cells

Materials needed:

- Microscope
- 2 slides
- 2 cover slips
- Iodine
- Onion skin
- Tweezers
- Wooden sticks

Procedure:

Onion cell

1. Remove a small piece of the inner surface of an onion skin.
2. Place the piece of onion skin on a slide.
3. Cover the piece of onion skin with iodine (one drop).
4. Place a cover slip over the onion skin.
5. Place the slide under the microscope and write down what you observed.

Cheek cell

1. Use the wooden stick to scrape some cells off your inner cheek. Make sure to scrape hard and long enough to get some cells.
2. Place what you have scraped off onto a slide.
3. Cover the cheek cells with iodine (one drop).
4. Place a cover slip over the cheek cells.
5. Place the slide under the microscope and write down what you can observe.

Conclusion:

Did you see the cell wall or cell membrane?

Did you see the cytoplasm?

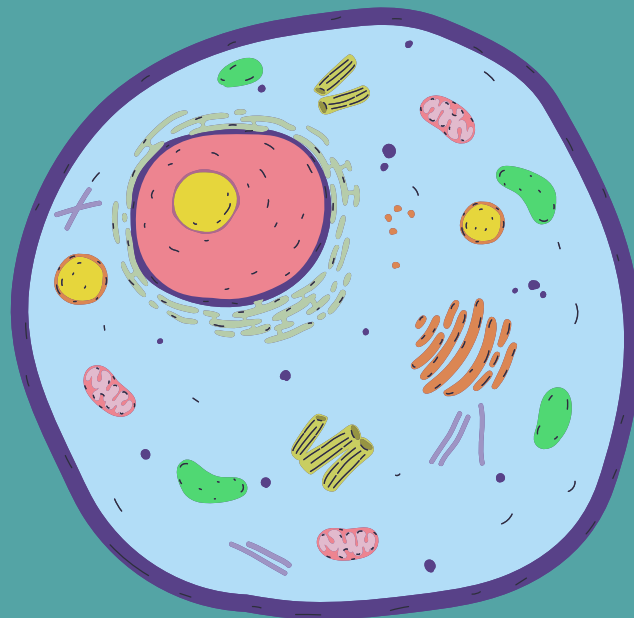
Did you see the nucleus?

Did you see a vacuole?

Lesson 2

Before lesson 2, students should go through the section 'animal cell and plant cells'. Here students will learn about the differences between plant and animal cells. During the full **100 minute** lesson, students will plan and start building a **3D model of a cell**.

Explanation of the activity: This will be the summative assessment of this course. Students can choose to either build a plant or animal 3D cell model. In this lesson, they start planning what they want to build and what materials they want to use. When they have figured that out they can start building their model. (They will have time in lesson 3 to finish their model)



Building a 3D model of a cell

You are going to build a 3D model of a cell from scratch. You can use any materials you would like, such as clay, cardboard, paper, playdough, etc.

You can choose what type of cell you would like to build:

- 1)Animal cell
- 2)Plant cell

For this project you need to hand-in a finished version of your cell model and an agenda that indicated which organelle is which with a short description of its role within the cell.

This project will be the end of unit assessment and will be graded summative.

Criterion A – Knowing and understanding

This is about your knowledge and understanding of science. Please use the attached task specific rubric to know how to do well.

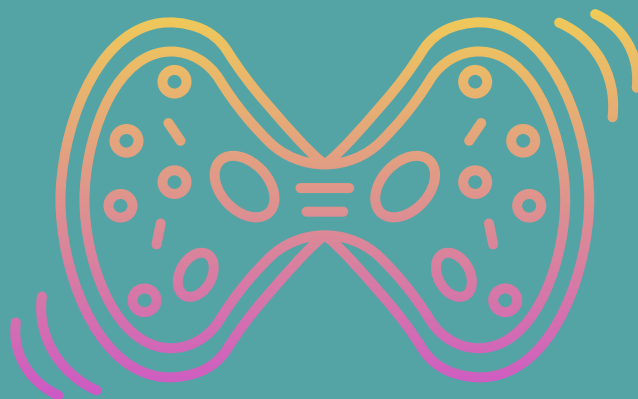
Task specific rubric

Achievement level	Level descriptor
0	The student does not hand-in their project.
1-2	I can: <ul style="list-style-type: none"> ● include 2-3 cell organelles ● hand in an agenda including a list of the cell organelles from the model ● show very little creativity to show the understanding
3-4	I can: <ul style="list-style-type: none"> ● include 4-5 cell organelles ● hand in an agenda including a list of all cell organelles of the model and an explanation of some ● show minimal creativity to show the understanding
5-6	I can: <ul style="list-style-type: none"> ● include nearly all of the cell organelles ● hand in an agenda including a list and explanation of all cell organelles of the model ● show some creativity to show the understanding
7-8	I can: <ul style="list-style-type: none"> ● include all cell (correct) cell organelles ● hand in an agenda including a list and correct explanation of all cell organelles of the model ● show lots of creativity to show the understanding

Lesson 3

Before lesson 3, students should go through the section 'Mitosis'. They will learn about the reason for cell division and the different phases a cell goes through. In the first **50 minutes** of the lesson, the students will be **modeling the process of mitosis**.

Explanation of the activity: Students will work individually. They receive two white circle cut out of an A4 paper and 6 candy strings (3 different colours, 2 of each colour). You have to print out a worksheet and hand it out to the students. Then you will give students instruction so what to do with the papers and candy strings. After you explained, give students 1-2 minutes to follow your instructions and draw what they see before them on their worksheet. The students will only have to fill out the first page of the worksheet. To help students that are struggling you can use candy strings to show what they have to do with them and also draw on the board what it should look like.

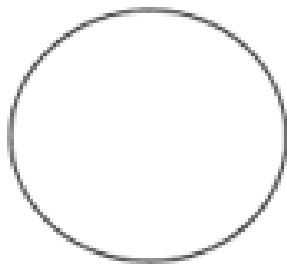


Task – demonstrate mitosis (Instructions)

Demonstrate mitosis with gummy worms using the following steps!

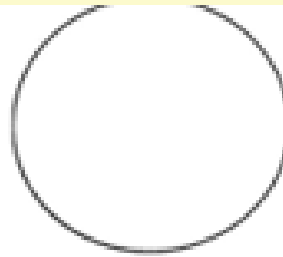
1. Put the two circles (the cell) on top of each other.
2. On the top circle, put 4 different coloured gummy worms (chromosomes). Draw this on your worksheet. This is **Interphase** (happens before mitosis starts).
3. Now group two of the same coloured gummy worms together and twist them in the middle to create an x-shape. Put the x-shapes back in the cell. Also draw this on your worksheet. This is **Prophase** (the 1st phase of mitosis).
4. Move the x-shaped chromosomes to the middle of the circle and line them up. Also draw this on your worksheet. This is **Metaphase** (the 2nd phase of mitosis).
5. Separate the chromosomes by untwisting the gummy worms. Leave them side by side and then move one string to the right and one string to the left. Do this for all of them. Also draw this on your worksheet. This is **Anaphase** (the 3rd phase of mitosis).
6. Now put both circles next to each other but make them still overlap a little. Place one set of chromosomes on each paper. Also draw this on your worksheet. This is **Telophase** (the 4th phase of mitosis).
7. Now separate both papers completely. The cells have divided into two identical daughter cells. Draw this on your worksheet. This is **Cytokinesis** (not part of mitosis anymore).

Worksheet

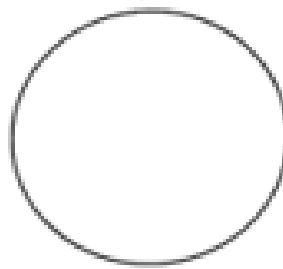


Drawing for Step 1,
Original Cell

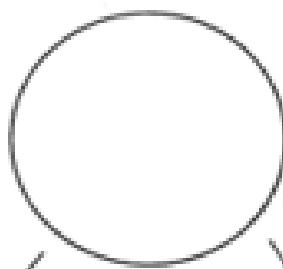
1st phase - Drawing for
Step 3.



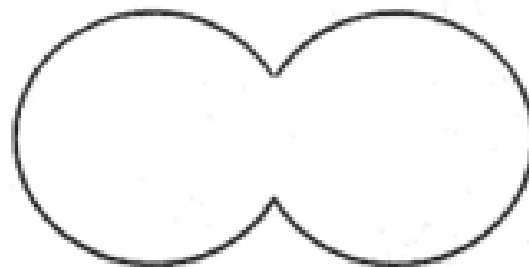
2nd phase - Drawing for
Step 4.



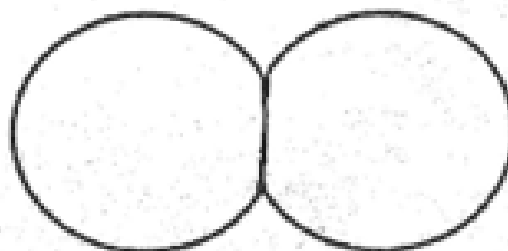
3rd phase - Drawing for
Step 5.



4th phase - Drawing for
Step 6.



Cell splits in two - Drawing
for Step 7.



Worksheet

Review Questions:

1. Compare the chromosome number of the parent cell with that of each daughter cell. _____

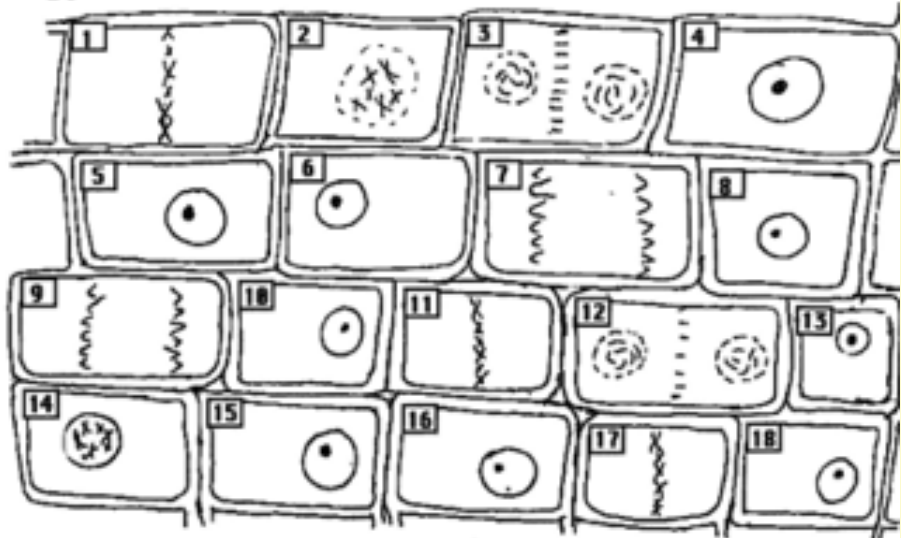
2. Compare the genetic information of the parent cell with that of each of the two daughter cells.

3. You have 46 chromosomes in each of your somatic cells. If you cut your arm, how many chromosomes would be in each newly formed skin cell? _____

4. What is the purpose of mitosis? _____

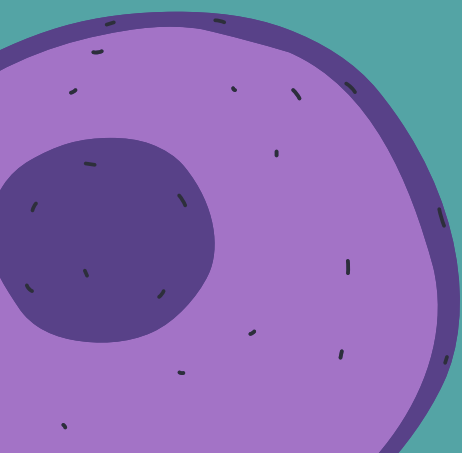
5. Examine the diagram below and label the phase each cell is in. Cells are either in original state, 1st, 2nd, 3rd, 4th or splitting phase

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____
11. _____
12. _____
13. _____
14. _____
15. _____



6. According to the diagram, cells spend most of the time in which phase? _____

The following 50 minutes of the lesson, the students get time to finish their 3D model of the cell which they started in lesson 2. If students are already finished or finish before the end of the lesson, they can fill out the second page of the worksheet



Online activities

This course has been divided into 4 online sessions together with a page for the learning objectives and a page for the programme schedule. The 4 online sessions have been divided into the following themes:

- 1) Introduction
- 2) Cell organelles and their functions
- 3) Animal cells and plant cells
- 4) Mitosis

On these pages, students can learn in a playful way about cells. The course has been designed in a story telling way. We have the story teller “Cosmo” who accompanies the students on their adventures. There are various ways students can interact with the content they should learn; videos, text, writing exercises, games, and simulations.

Introduction

This section is supposed to be an introduction to cells for students to get an idea of what cells are and how they are connected to their life. There are no classroom activities following after this introductory session. Students should have a look at this page before looking at the page ‘cell organelles and their functions’.

On this page, first Cosmo introduces himself briefly in form of a little story. After this, students are given the choice to watch a video (if they have not learned about cells before) or skip the video and move to the next activity (if they have learned about cells before).

Let's watch this short video which will explain a bit more...

(If you already know a lot about cells you can skip this video and jump to the padlet)

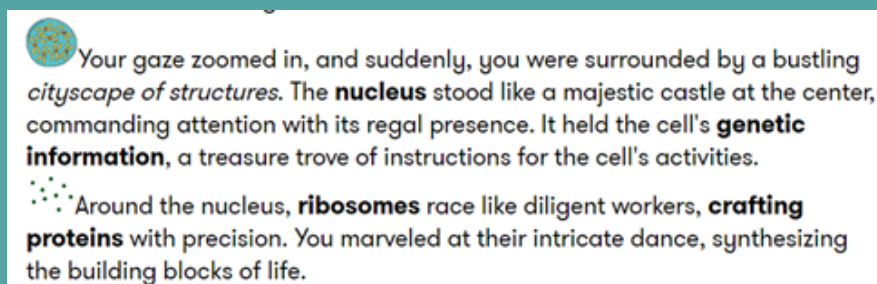


The video gives a short introduction to what cells are and where we can find them in our everyday lives. Then students can click a link that brings them to a padlet where they are supposed to answer question like “what are cells” and “what did you take away from the video”. By giving students the choice to either watch the video or not, UDL has been applied and students can take ownership/responsibility for their learning process. The padlet is used to improve writing skills and students are forced to put their ideas into words. They can also see what their peers are saying and can react to their comments.


Cell organelles and their functions

These activities help fulfil the second learning objective. There are different ways of communicating the content to the students such as reading a text, watching a video, or flash cards. Advise the students to have a look at the flash cards and either choose the video or the text.

For students that like learning by reading there is a text in form of a story that tells them about the cell organelles and their functions. As a scaffolding, the names of the cell organelles are written in bold and their functions in cursive.



If reading is not their preferred learning style then there is a video that give the same information. Also on this page, students are given the choice to assess their own knowledge and skip one of the tasks.



Did you already remember the functions of all organelles?
Yes? Then you can check yourself with a quiz at the end of the page!
Not yet? Cosmo has some videos to support you!

If there are some music fans within your classroom, there is also a song that can help them remember the different cell organelles. As a last activity, students should take a quiz which assesses their knowledge of the new learned content. There is immediate feedback after every question.

For students that would like to prepare for the upcoming lesson or would just like to know what you will be doing, there is a link to the classroom activities at the bottom of the page.

Animal cells and plant cells

This section helps to fulfil the first learning objective. Students can play various games to deepen their understanding and review the content from the last session.

Students start with a memory game where they have to find the matching pictures of the cell organelles. On every card the name of the organelle is also mentioned to help students remember the names and what they look like. The game is used to enhance motivation and focus.

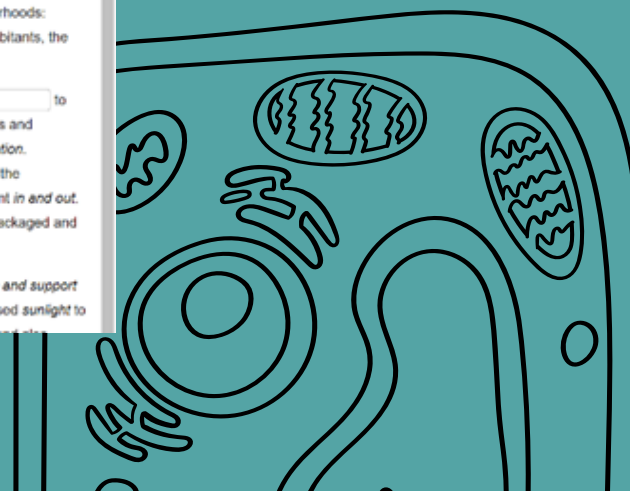
Students then should look at an infographic and use the information to fill out the blanks in the text below it. As scaffolding, the missing words are written underneath the text. In this exercise, students have to look for the differences between plant and animals first by themselves, improving their critical-thinking skills.

Fill in the missing words

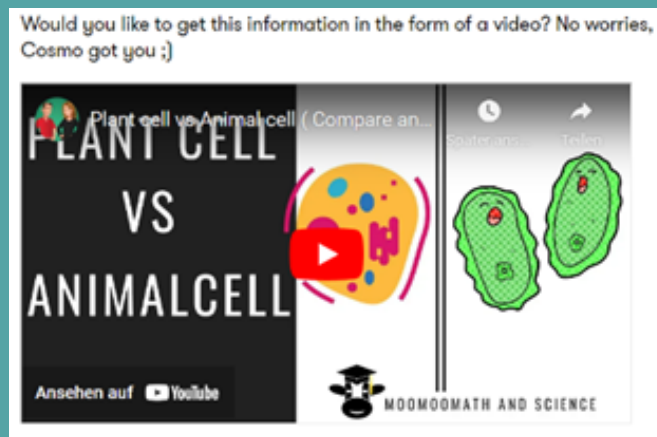
Once upon a time in a friendly town, there were two special neighborhoods: **Animalville** and **Plantland**. Each had its unique charm, and the inhabitants, the **cells**, had unique characters.

In both neighborhoods, they had a [] who controlled it, [] to built things, and [] the power plants. There were also roads and bridges, which the cells called [], that facilitated transportation. Surrounding these neighborhoods their was a flexible barrier called the [] that acted as a protective shield and controlled what went in and out. They also had a post office, the [], where molecules are packaged and transported.

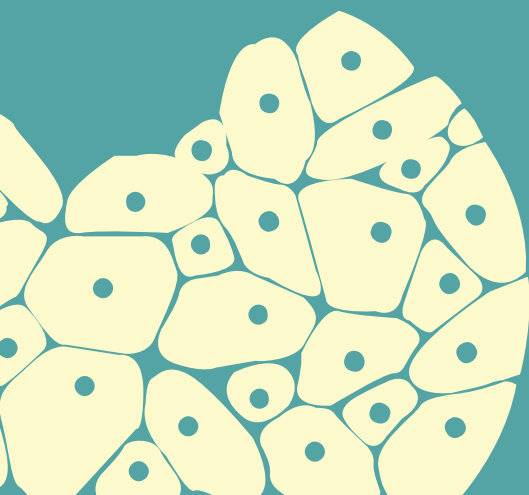
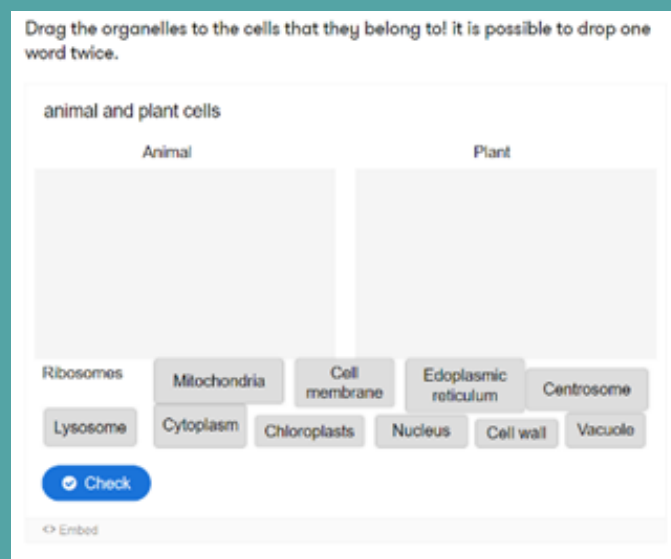
Over in Plantland, they had a strong [] for more protection and support additionally to the cell membrane. Sunlid parks called [] used sunlight to



Then there is a video students can watch to get more explanations and to get the information in a different form.



To check their understanding, there is a drag and drop game where students have to put the cell organelles in the right zones; animal cells and plant cells. After completing this activity, they can check their answers and get immediate feedback.



Mitosis

This section will help to fulfil the third learning objective. On this page, students learn about mitosis through videos, songs, flash cards, infographics, and simulations.

To get students motivated and excited about the topic, they start with a song about mitosis which helps to remember the names and the order of the phases. For students that prefer rap songs there are two choices of songs.



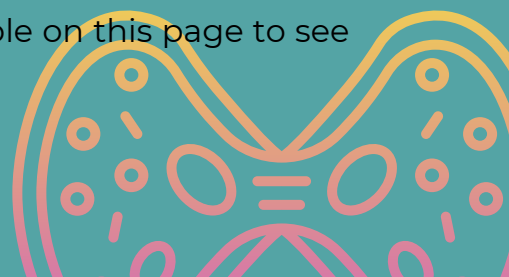
After that, there will be a short definition of mitosis be following together with a picture to visualize what happens. On the flash cards, students can look at pictures of the phases and on the back they find an explanation of what is happening within the cell.

You must be thinking "**MITOSIS???** What is that?"

Mitosis is a type of cell division that results in **two** daughter cells. In this process, two genetically **identical** daughter cells are formed. The purpose of Mitosis is **asexual reproduction, growth, and repairing** damaged tissue.

If students prefer to watch a video or need extra explanations after the flash cards, there is a video option as well which provides valuable information about the topic.

For the more visual learners, there is a simulation available on this page to see the different phases and how they blend into each other.

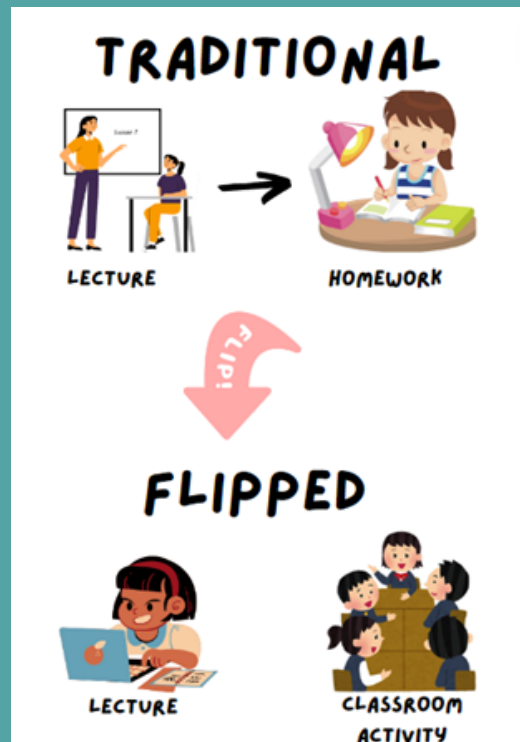


Theories

This course has been designed according to various theories such as ‘the flipped classroom approach’, ‘bloom’s taxonomy’, ‘SAMR’, and ‘Universal Design for Learning (UDL)’.

Flipped Classroom

The ‘flipped classroom’ approach has been used to create this course. This approach is an innovative educational strategy that reverses the traditional structure of learning and teaching. In a flipped classroom, lectures and readings are delivered to students outside of the classroom, usually through videos or online resources. This approach allows students to interact with the content in their own pace and frees up crucial classroom time for interactive and collaborative activities that



help reinforce the newly learned contents. In these face-to-face lessons, students stand in the centre and the teacher can focus on responding to students questions, leading discussions, and offering practical exercises. This model seeks to move the focus from passive learning to active student involvement resulting in developing greater knowledge of the subject matter through individualized experiences. The flipped classroom approach fosters a more dynamic and engaging learning environment while supporting student-centred learning.

Flipping the classroom has multiple benefits:

Students get the opportunity to actively engage with the content at their own pace leading to better understanding

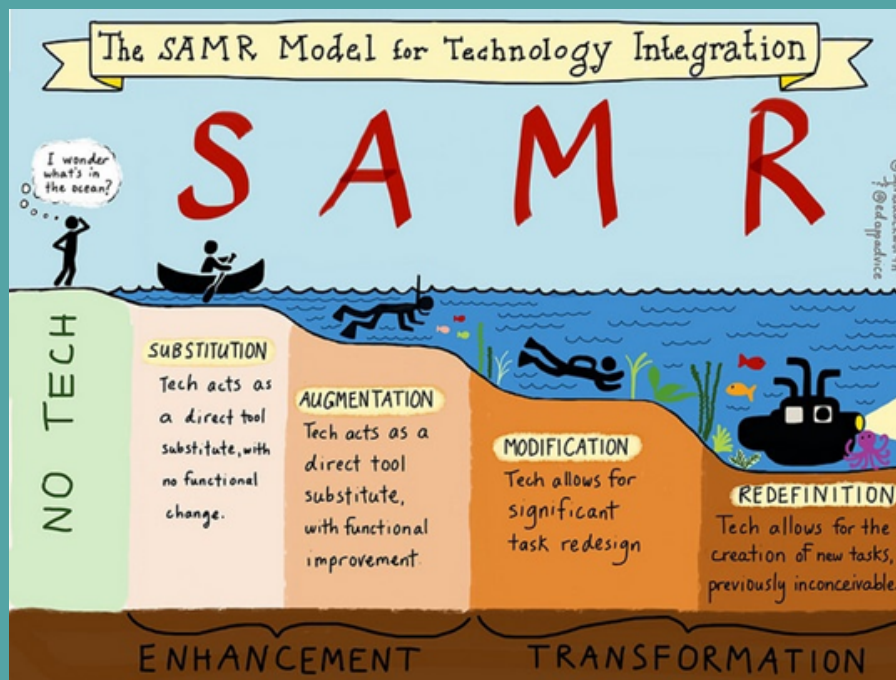
Classroom interactions prioritize interactive activities, discussions, collaborative projects, and practical exercises

Learning can be individualized due to flexible schedules

Teacher can provide targeted support, meet individual needs and provide immediate feedback

More time for active engagement encourages critical-thinking and problem-solving skills

SAMR



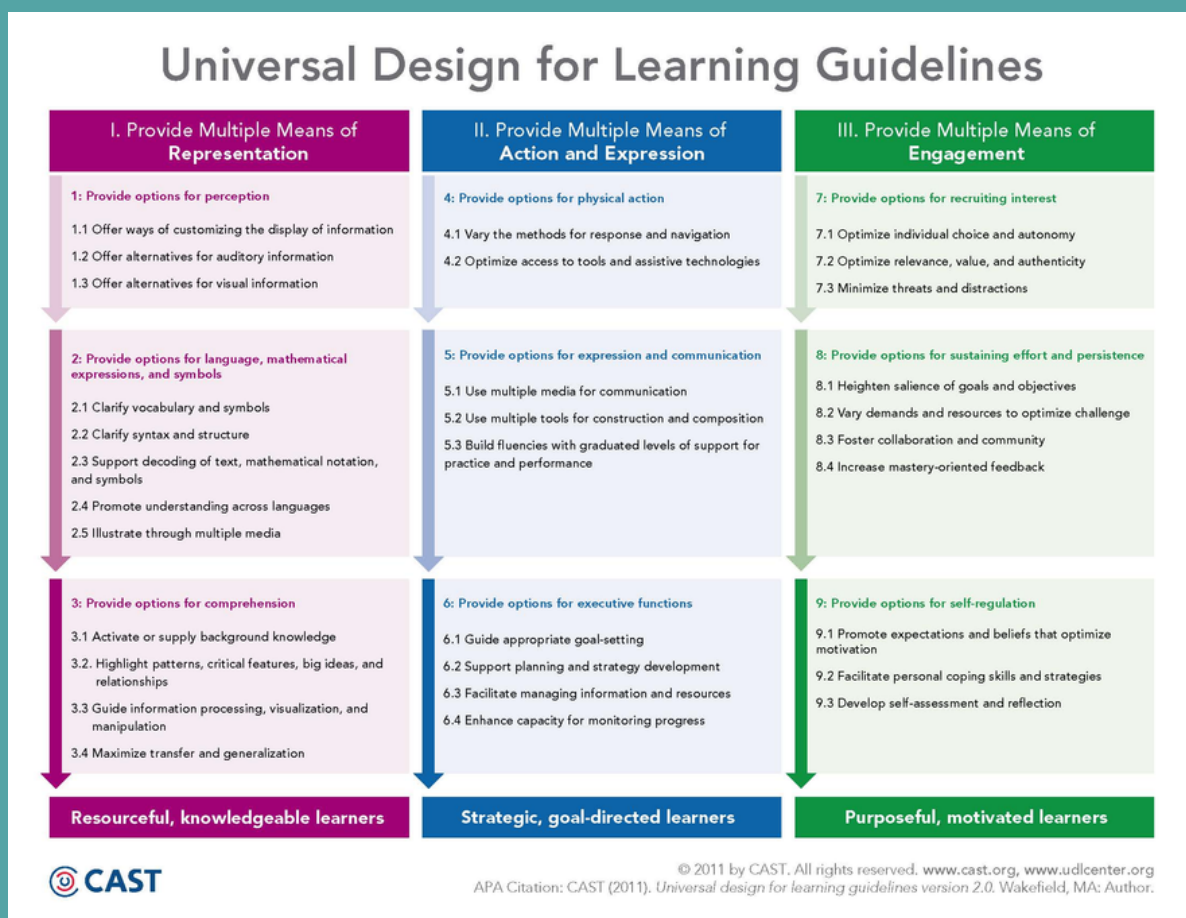
Dr. Ruben Puentedura's SAMR model divides technology integration into four levels: substitution, augmentation, modification, and redefinition. Whereas substitution is a direct replacement, **augmentation** improves tasks, **modification** uses technology to modify and redesign tasks, and **redefinition** goes beyond conventional approaches to design new tasks previously inconceivable. The SAMR model encourages teachers to use technology to implement creative teaching strategies that improve comprehension and students engagement. In a flipped classroom the SAMR model can be incorporated the following way:

- Substitution might involve online readings
- Augmentation enhances with multimedia
- Modification transforms tasks (e.g. collaborative online projects)
- Redefinition fosters for example interactive virtual discussions and creative digital projects.

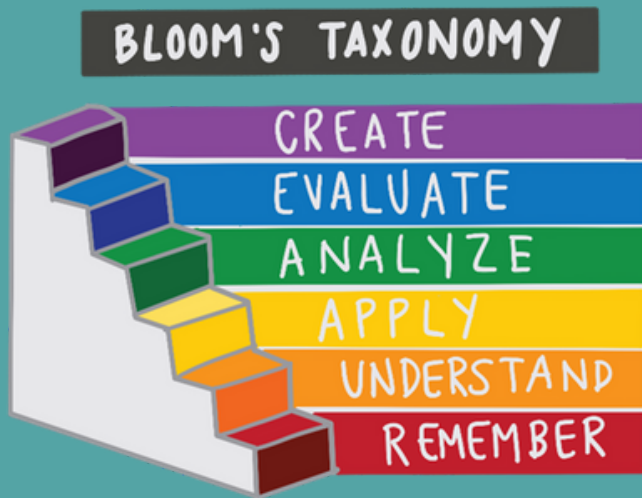
Universal Design for Learning (UDL)

Universal Design for Learning (UDL) is an educational framework that aims to make learning accessible to all learners, regardless of their learning styles and individual abilities. By providing multiple means of representation, interaction, and expressions, UDL is a flexible approach. It encourages the use of various teaching strategies and resources while acknowledging the unique needs of students. UDL fits in perfectly with the flipped classroom approach because it encourages teachers to use a variety of media to deliver the material and to meet the needs of students with different learning styles. UDL is split into three aspects:

- Provide multiple means of representation
- Provide multiple means of action and expression
- Provide multiple means of engagement



Bloom's Taxonomy



Benjamin Bloom developed Bloom's Taxonomy, a six-level framework for classifying cognitive skills. It begins with simple activities like remembering and understanding and moves on to more complicated ones like application, analysing, evaluating,

and creating. Teachers can create learning objectives and assessment that are in line with different degrees of cognitive depth by using taxonomy as a guideline. Bloom's Taxonomy, which prioritizes critical thinking over memorizing, encourages teachers to develop higher-order cognitive abilities in order to prepare them for a deeper and more long lasting understanding of the material.

In a flipped classroom, Bloom's Taxonomy is used in the following way: remembering and understanding happens in the lectures and readings that happen outside of classroom time. Applying, analysing, evaluating, and creating happen during classroom time. This way, everyone is more involved and can understand contents better.

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The picture used in the section 'Flipped Classroom' I created myself using Canva.

The pictures used in the following sections have been taken from these sources:

'SAMR': <https://talktechwithme.com/resources/integration-stations/samr/>

'Universal Design for Learning (UDL)':

<https://blog.yorks.ac.uk/moodle/2015/11/30/universal-design-for-learning-udl/>

'Bloom's Taxonomy': <https://www.teachfloor.com/blog/how-to-write-learning-objectives-using-blooms-taxonomy>

The other pictures in this document are screenshot from the online learning environment: <https://www.myschoolsnetwork.com/projects/cell-cebration-a-microscopic-adventure>