

Encouraging the development of higher-order cognitive skills via applied exercises and web-based self-assessment to teach the basic principles in molecular biology.

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Introduction:

The year 2020 not only challenged our humanity, but also the way we teach our students. More than once, the question arose, if higher education can be achieved from the distance. Thus, making the concept of **blended learning**, which combines **online educational methods** with **traditional classroom** interactions, more important than ever. Science in particular faces many obstacles in the attempt to support students to embed new knowledge and to encourage the development of **higher-order cognitive skills**. A very underestimated obstacle is the **variety of knowledge basis** from previous educational institutions. An approach coping with these challenges shall be presented here in form of a hybrid course in its main 3 steps.

Aim:

The aim of this course is to foster understanding of basic concepts in Molecular Biology by implementing **blended learning elements** to enhance the comprehension of basic topics and to provide opportunities for **self-assessment**.



1 Web-based training

students prepare **at home** for the course units by completing **interactive** chapters prepared with the learning software "Articulate Storyline". Learning outcomes are assessed by **online quizzes**.



Benefits:

- allows time to focus on selected topics in lecture
- self-paced learning
- immediate self-assessment with quizzes
- students are well prepared for the lectures

2 Lectures

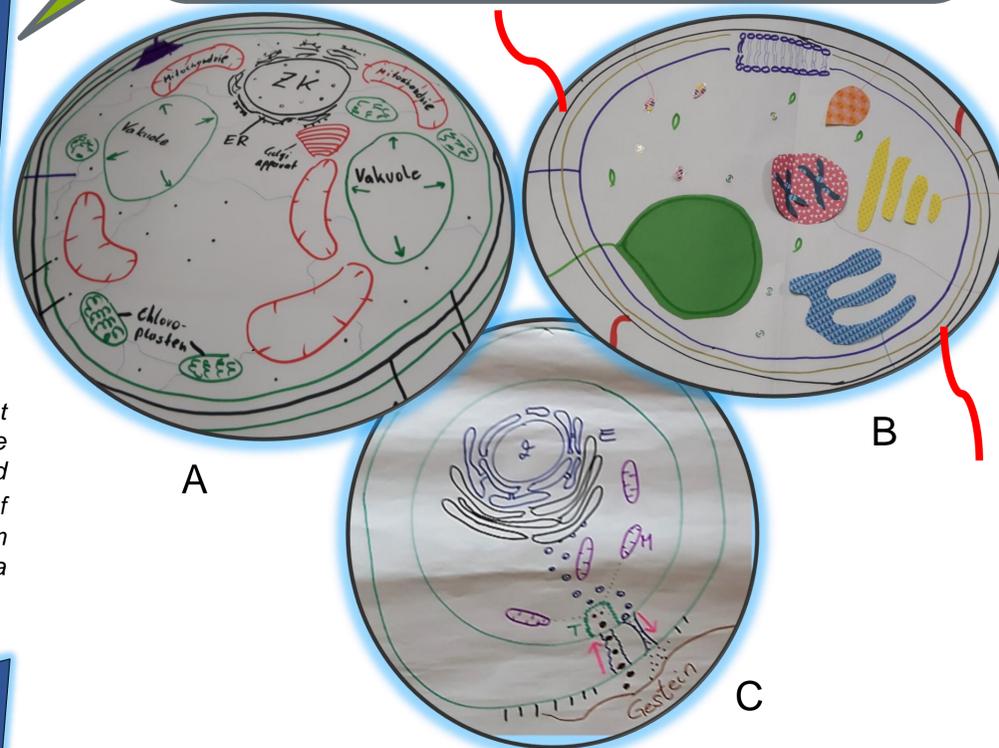
theoretical **frontal** lectures, where **key messages** are repeated, and study-oriented topics are presented. Additional guided **group exercises** to promote analytical skills and abstract thinking.

Benefits:

- repetition of theory
- possibility for questions
- students apply and combine their knowledge to solve problem-based challenges in group exercises
- group exercises allow to process the learned subjects

Figure 1. Example for group exercise;

Each student group chooses a given (fictional) organism living on a faraway planet with certain conditions and has to design a cell for that animal regarding: whole structure of cell, membrane composition, types and amount of cell organelles and has to present the design and explain why they chose this design. A) shows a cell of an organism living on a planet with high gravity; B) shows a cell of an organism living on a planet with extreme heat; C) shows a cell of an organism living on a planet with extreme cold.



3 Revision course

a voluntary **revision course** allows interactive repetition of the acquired knowledge with the focus on **student-to-lecturer dialogue**.

Benefits:

- smaller group
- time for questions (encourages shy students to ask)
- repetition and consolidated knowledge

Results:

According to the students the group exercises allowed to process the learned subjects, promoted the group climate and were a convenient diversion from the frontal lecture format. Students who attended the revision course on a regular basis showed a better performance at the final exam and exceeded especially at interdisciplinary questions.

Conclusion:

The combination of web-based training elements with frontal lecture elements, guided exercises and an optional revision course can teach students the basics of biology in an understandable way. This course structure is especially applicable to teach basic subjects for groups of students with varying initial knowledge.

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