

COMPUTER MODELING OF BIOCHEMICAL PROCESSES BY POWERPOINT

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Introduction

We encounter a negative approach to the teaching of biochemistry from both students and many teachers at high schools. That leads to an effort in creating new didactic instruments, which should help in ameliorating the biochemistry classes of high schools. These didactic instruments could be educational presentations made in PowerPoint application aimed on high school teachers of chemistry. The simplification of teaching while using PowerPoint presentations consists in several aspects, as are e.g. simple manipulation with prepared presentations, possible distribution via the Internet, increased motivation of students or possibility to concretize the course of biochemical processes with the aid of animated pictures.

Software application Microsoft PowerPoint

The software application Microsoft PowerPoint is a part of the Microsoft Office package. It is an easy-to-handle tool for creation of presentations. This application enables to create eye-catching presentations with graphic, animations and multimedia.

Advantages and disadvantages of using Microsoft PowerPoint in teaching Biochemistry

Advantages:

1. *Easy availability of the PowerPoint software*
PowerPoint software is a part of the Microsoft Office package.
2. *Easy creation of presentations:*
The PowerPoint application is easy-to-handle and enables creating time scanty presentations.
3. *Inserting notes:*
The teacher can insert own didactical notes in the presentations.
4. *Easy handling with prepared presentations:*
The prepared presentations can be taken from one computer to another.
5. *Distribution via the Internet:*
The presentations can be saved on Internet pages and can be easily distributed e.g. via e-mails
6. *Enhancing motivation of students for teaching biochemistry:*
The presentations enable insertion of interesting biochemical pictures, video and sound or creating animations which dynamics should attract the viewers and make the teaching process more efficient.
7. *Explanation and the possibility to concretize the course of biochemical processes using animated pictures:*
The presentations make understanding the subject matter easier.

Disadvantages:

1. *The Microsoft PowerPoint versions are not unified:*

Not all computers have installed the same version of Microsoft Office. When transferring a presentation from one computer to another there can occur unwanted changes in the presentation (e.g. some animation need not be functional, there can be changes in writing or colors etc.)

2. *School equipment:*

Some schools need not have available a classroom with a data projector

3. *Students can be overdosed with information:*

Teachers can want to use inadequate number of pictures during a lesson with the explanation that the students will have the presentations at home available and will be able to have a look at them one more time. The teacher should choose adequate number of pictures and not overload his/her students with excessive and mostly irrelevant information

4. *Possibility of using excessive information:*

Excessive use of animations routes attention of students away from the subject mater. Students cannot be concentrated sufficiently on the subject mater.

PowerPoint presentations for teaching biochemistry

In 2004 we started to develop on-line courses in the Moodle environment. Moodle (*Modular Object-Oriented Dynamic Learning Environment*) is a software pack designed for creation of educational systems and electronical courses on the Internet.

The courses are called: „Education in biochemistry I - Metabolism“ and „Education in biochemistry II - The Cell and Nucleic Acids“. These two on-line courses were created for teaching biochemistry at the Faculty of Science, Charles University in Prague.

First course is focused on teaching metabolical processes in human body. It is divided into twelve parts and includes six explanatory presentations (Digestion, General Metabolism, Metabolism of Proteins, Metabolism of Sugars, Metabolism of Lipids, Citric Acid Cycle and The Electron Transport Chain), two presentations with biochemical tests (Biochemical Tests 1-Digestion, Biochemical Tests 2-Metabolism) and three multiple-choice tests.

The second course is focused on knowledge concerning the cell and nucleic acids. The course is divided into eleven parts and includes six explanatory presentations (The Cell, Nucleic Acids, The Chromosome, Replication, Transcription, Translation) and five presentations for verification of student's knowledge (The Cell-Test, Biochemical Tests 3-Nucleic Acids and The Chromosome, Biochemical Tests 4-Replication, Biochemical Tests 5-Transcription, Biochemical Test 6-Translation).

Both courses are designated for students of Teaching of Chemistry at the Faculty of Science, Charles University in Prague and for further education of teachers.

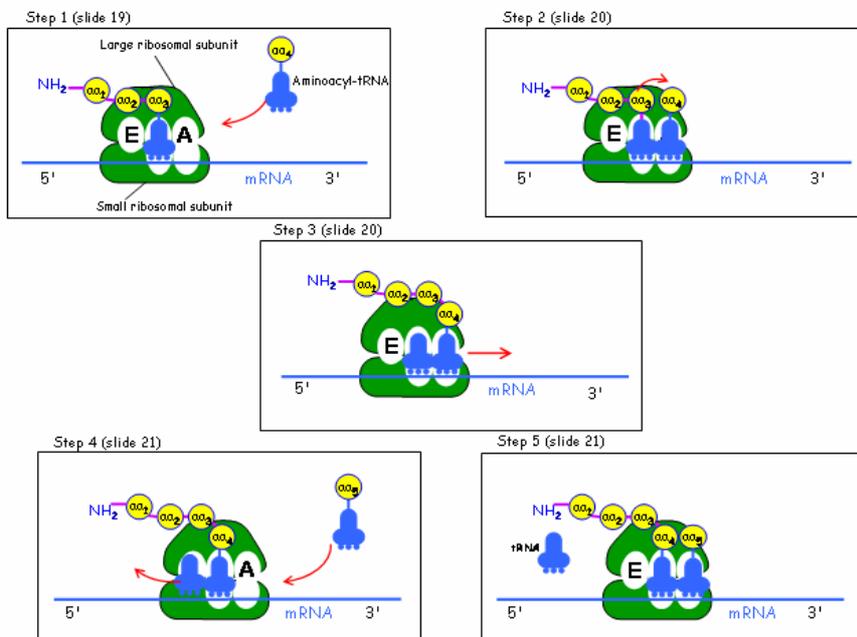
These presentations contain a number of animations, which should help students to master important biochemical notions, reactions, cycles etc. The principle lies in the use of fistful of appealing pictures and schemes, which should absorb students and raise the efficiency of the teching process with their dynamism.

In the process of creation PowerPoint presentations I drew from variety of biochemical and biological books [1, 2, 3, 4, 7, 8, 9, 12, 13, 14, 17, 18, 19, 20, 22, 24, 27], high-school textbooks [6, 11, 15, 16, 23, 26] and encyclopedies [5, 25].

The Cell – Test and Biochemical tests 1-6 are also created in the form of PowerPoint presentations. In the construction of tests we came from the content of the explanatory presentations and used literature [10, 21]. We can find following types of

test elements in the tests: assignment tasks, tasks with the choice of response (only one response is correct, tasks with the choice of response (possibly more correct answers) and tasks with brief answer.

Figure 1: Elongation of Translation (from presentation „Translation“)



In the figure 1 there are represented animated steps of three slides (19-21) illustrating the elongation of translation.

In the first step is the aminoacyl-tRNA bound to the ribosome in the A site. The second step is peptide bond formation between the A site amino acid and the growing peptide chain. The third step involves translocation. The ribosome is moved along the mRNA. The uncharged P site tRNA is released from the ribosome and the tRNA bearing the growing peptide chain moves into the P site (step 4). The next aminoacyl-tRNA is bound to the ribosome in the A site (step 5).

In multiple-choice tests (test A, B and C) is always composed of 10 or 11 test elements. In majority of cases these are tasks with the choice of response, in which student chooses from two or three alternatives, where only one alternative is correct.

Summary

Using PowerPoint presentations offers a variety of compelling opportunities, which could lead to better efficiency of the biochemistry teaching at high schools. These presentations could be an interesting tool for teachers, who could use them during explanation of new subject matter or in repeating the subject matter already explained.

Both educational courses mentioned above are currently available at the Internet address <http://dl.cuni.cz/> under the category „Chemické“. Courses are designated for students of Teaching of Chemistry at the Faculty of Science, Charles University in Prague and for further education of teachers.

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The complex network of biochemical reaction/transport processes and their spatial organization make the development of a predictive model of a living cell a grand challenge for the 21st century, listed as such by the National Science Foundation (NSF) in 2006.[5]. A whole cell computational model for the bacterium *Mycoplasma genitalium*, including all its 525 genes, gene products, and their interactions, was built by scientists from Stanford University and the J. Craig Venter Institute and published on 20 July 2012 in *Cell*. [6]. A dynamic computer model of intracellular signaling was the basis for Merrimack Pharmaceuticals to discover the target for their cancer medicine MM-111. [7]. Membrane computing is the task of modelling specifically a cell membrane. Recommend biochemical process formulas, instrumentation, or equipment specifications, based on results of bench or pilot experimentation. Prepare piping or instrumentation diagrams or other schematics for proposed process improvements, using computer-aided design software. Lead studies to examine or recommend changes in process sequences or operation protocols. Interacting With Computers – Using computers and computer systems (including hardware and software) to program, write software, set up functions, enter data, or process information. Communicating with Supervisors, Peers, or Subordinates – Providing information to supervisors, co-workers, and subordinates by telephone, in written form, e-mail, or in person. The biochemical mathematical models called Activated Sludge Model (ASM), which is one of the simplest, describe the conversion of organic compounds, phosphorous and nitrogen. More complex models (such as Mantis2) developed in last years integrate ASM with anaerobic digestion processes, precipitation and/or anammox. The model of AS bioreactor was extended by primary settler and anaerobic digestion chamber in order to develop a complex model of a WWTP. Energy balance followed the simulations of wastewater and solids treatment processes. The operating cost model was used to simulate aeration and pumping energy concurrently to wastewater processes simulation.