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# SPECIFIC USES OF INTERNET RESOURCES FOR TEACHING BIOLOGY

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**ABSTRACT**
*Within this study we describe specific examples of the internet resources use in a biology lesson and/or laboratory, the advantages and disadvantages being also underlined. These examples refer to the illustration of a concept of phenomenon, to the assurance of a visual interactive component to a lesson where the teacher has not proper didactic tools and to the discernment of useful information from inaccurate web sources.*

**KEY WORDS:** *internet resources, biological online teaching tools, scientific information search and selection*

## INTRODUCTION

Personal computers, laptops, tablets, smart phones, iPhones and other mobile devices are currently widely used through the world by people of all ages. Primary and secondary school students are generations that have been online since a young age and in these conditions the classroom must inevitably change and teachers must take advantage of these abilities of their students. It does not mean that computers can replace teachers, but they can have specific uses in a classroom and/or laboratory and may be successfully integrated in teaching and learning processes. The use of computers enables teachers not only to visualize and explain some processes, phenomenon or practical applications, but also to guide students in internet search and useful information selection, graphing and, not at last, in word processing. Furthermore, the use of computers allows teachers to integrate the multiple intelligences theory in their classroom assuring the participation of the biggest part of the students to the lesson.

The low interest and motivation of primary and secondary school students in learning biology and other natural sciences is already well known (Fensham, 2006; Ekici & Hevedanli, 2010; Akarsu & Kariper, 2013). There are some published data revealing that computer assisted instruction and the use of the new technologies in biology classroom contributed to the change

of the attitude of students toward sciences (Sternberg, 1999; Sandersa & Morrison-Shetlara, 2001; Preszler *et al*., 2006), to the increase of retention of information (Faur, 2012) and the ability of students to solve problems (Huppert *et al.,* 2002).

The aim of this paper is to illustrate a few specific ways of using internet resources in biology classrooms in a way to help both teaching and learning processes, to take into account the multiple intelligences of students and to integrate the active participation of those students that are fans of using gadgets instead to learn biology from the printed books. We do not consider in this study the use of online scientific databases for structural biology and specific online tools for basic bioinformatics, these topics being presented elsewhere (Ciorsac *et al.,* 2015).

## MATERIALS AND METHODS

Computer assisted instruction is one of the active and participatory learning method used in biology teaching (Sîrbu & Ianovici, 2011) that cannot be undervalued in the contemporary world. Computers may be used in many ways at all the levels of biology teaching: primary schools, secondary schools, high schools and universities. Here we focus on a specific use of the internet resources in biology teaching at university level with the aim of training students how to discern useful information from inaccurate web sources.

Internet resources may be used for the following purposes in biology teaching in higher education: (i) illustration of a concept or phenomenon; (ii) assuring a visual interactive component to a lesson where the teacher has not proper didactic tools; (iii) building a scientific vocabulary by developing science reading and writing skills; (iv) using scientific methods and developing science understanding; (v) developing scientific reasoning by critically thinking; (vi) developing scientific research skills by use of scientific databases, visualization, mapping and analysis of the data. Each of these purposes is illustrated further.

Illustration of a concept or phenomenon by using online animations allows to address the different learning styles of students and when it includes some interactivity, its efficiency is increased (Stitht, 2004). In this way, the students' attention is captured and the teacher can differentiate the instruction according to students' learning needs and preferences. By assuring a visual interactive component to a lesson where the teacher has not proper didactic tools we refer to the use of internet resources for illustration and interactive analysis of the anatomical structures of plants and animals instead of old plastic models and textbook images.

Scientific vocabulary differs from vocabulary used in daily social interactions. In the educational system, scientific vocabulary is used in instruction, textbooks and also in exams. A few ideas about using internet facilities for developing science reading and writing skills and consequently improving scientific vocabulary are presented further.

Online interactive simulations and virtual labs are internet resources that allow students to develop their skills for using scientific methods and developing science understanding.

In the everyday life we are targets for pseudoscientific information and students fail to evaluate the trustworthiness of information to which they are exposed. Developing critical thinking of students by improving their scientific reasoning is an important outcome of a biology education and the internet resources may also help in this situation.

The biological scientific databases are accessible free online and they include associated visualization and analysis tools, constantly and consistently contributing to developing the scientific research skills of the students.

## RESULTS AND DISCUSSIONS

*Use of internet resources for illustration of a biological concept or phenomenon*

Transport of different kinds of particles across the cell membrane is easier to teach and understand using animations. An online resource for these animations is found at the following URL http://www.sumanasinc.com/webcontent/ animations/content/diffusion.html and is illustrated in the figure 1 (Shuster *et al.,* 2012). There are interactive keys that allow to students to pass from one type of membrane transport to another and there also are explanations concerning the transport.

Students also have the opportunity to access the URL from home and to learn this concept in their own rhythm using the animation and repeating it as many times as they need. Of course, there are many online resources concerning animations and movies illustrating a biological concept or phenomenon. Before to recommend such a resource to students, teachers must verify it and indicate those resources that are adequate to the level of their students. A few examples of online resources that may be used for biology teaching to students (and also to pupils, if translation is assured) are presented in Table 1.

*Assuring a visual interactive component to a lesson where the teacher has not proper didactic tools*

Usually, these adequate internet resources refer to photographic atlases, illustrated encyclopedia, videos and interactive movies of anatomical structures of plants and animals which are accurate from scientific point of view and visually compelling.

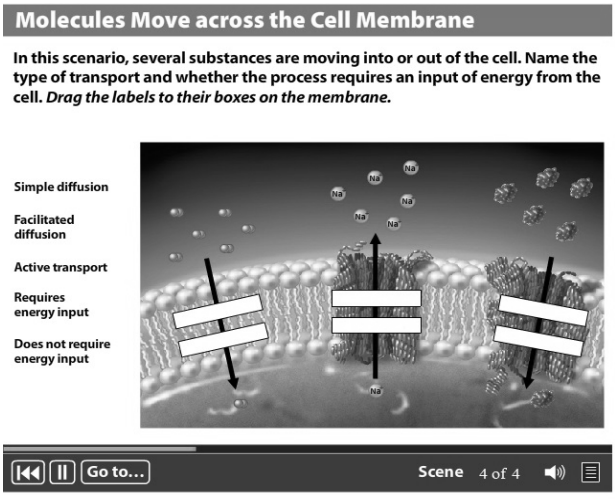


**FIG. 1. Illustration of an internet resource for animation used in teaching the transport across cell membranes** (http://www.sumanasinc.com/webcontent/animations/ content/ diffusion.html – accessed in 03.04.2016)

**TABLE 1. Internet resources containing animations and movies illustrating biological concepts and phenomenon**

| URL | Short description of information that is illustrated |
|---|---|
| https://www.stolaf.edu/people/giannini/biological%20anamations.html | This resource contains short animations concerning some biological processes: hydrogen bonding, membrane organization and fluidity, proteins organization and folding, membrane transport, cell structure, cell division, metabolism pathways, molecular genetics. |
| http://www.sumanasinc.com/webcontent/animation.html | This resource belongs to the Sumanas Inc that develops accurate high-impact interactive products for higher education. For biology, there are online animations and tutorials concerning general biology, microbiology and molecular biology. |
| http://www.learnerstv.com/animation/Free-biology-animations-page1.htm | Learnerstv.com. is a comprehensive site providing downloadable video lectures, animations and online tests in the fields of sciences, including biology. The subjects of animations cover all the areas of molecular and cellular biology and the anatomical structures for humans. |
| http://www.hhmi.org/biointeractive/short-films-collection | BioInteractive in another comprehensive site containing animations, videos, interactives and virtual labs in many fields of sciences. There are short films (10-30 minutes) in the fields ranging from genetics to earth science, providing examples of how science works, how evidence is assessed and how conclusions are reached. |
| http://www.hhmi.org/biointeractive/explore-virtual-labs | BioInteractive virtual labs contain simulations in which students are involved in performing experiments, collecting data and answering questions to assess their understanding. |
| http://www.biology.ualberta.ca/facilities/multimedia/index.php?Page=250 | This site, belonging to the University of Alberta, offers online animations concerning many subjects in plant and animal biology. |

*Assuring a visual interactive component to a lesson where the teacher has not proper didactic tools*

The biggest part of these types of resources concerns the anatomy of the human body, but there also are some web resources concerning the anatomical structures of domestic animals (usually conceived for veterinary students, but also for comparative anatomy purposes). Concerning plant anatomy, there are a few illustrated atlases and encyclopedia. A small number of examples of online resources that may be used for the purpose of this section are presented in Table 2.

*Building a scientific vocabulary by developing science reading and writing skills and using scientific methods and developing science understanding*

Building a scientific vocabulary by developing science reading and writing skills and instituting the student's abilities for using scientific methods and developing science understanding using internet resources are purposes that can be fulfilled in a biology lesson in a few ways: (i) use of online dictionaries; (ii) creation of a discussion forum to engage all the students where they must debate about the meaning of a scientific text, by discussing an item or by expressing their agreement or disagreement; (iii) using as homework assignment an online scientific text with missing words that students must fill and that provides a score and allows to be repeated; (iv) asking students to solve, create, share, modify online puzzles, polls and timed quiz. The developing of science reading abilities for those students that provide research skills may be also performed by analyzing the content of the research papers.

**TABLE 2. Internet resources containing interactive movies and illustrations concerning the anatomical structures of plants and animals**

| | |
|---|---|
| http://www.ikonet.com/en/health/virtual-human-body/index.php | Virtual Human Body is a web site and a iPhone, iPad and Android devices free application that includes an interactive navigation window allowing the student to overlap organs, bones and muscles at will and to explore the interrelationships between the various systems composing the human body. |
| http://www.real3danatomy.com/index.html | This site belongs to Bristol University and offers 3D presentations of canine anatomy. |
| http://www.vetvideos.com | This website includes educational videos for veterinarians, but they may also be used for comparative anatomy. |
| http://botweb.uwsp.edu/anatomy/ | This unique academic resource belongs to the University of Wisconsin and contains an atlas revealing the elements of plant structures. |

*Developing scientific reasoning by critically thinking*

The use of internet resources for development of critically thinking and scientific reasoning of students may be implemented in a biology lesson by asking students to compare, discuss and argue about the information concerning the same subject, but contained in a few distinct web sites. Such an activity contributes to the development of fundamental thinking operations of students: induction, deduction, comparison, analysis, assessment and synthesis.

**TABLE 3. Online free accessible databases used in biology teaching and research**

| | |
|---|---|
| www.ncbi.nlm.nih.gov | The web server of the National Centre for Biotechnology Information provides access to databases concerning biomedical and genomic information. |
| www.uniprot.org | UniProt is a protein sequences database. |
| http://www.rcsb.org/pdb/home/home.do | Protein Data Bank is a database containing spatial structures of proteins and of the complexes of proteins with various ligands. |
| www.genome.ad.jp | GenomeNet is a Japanese network of databases and computational services for genome research. |
| http://bioinformatics.charite.de/supercyp/ | SUPERCYP is a database containing information about the genetic polymorphism of the human cytochromes and its effects on the metabolism of drugs and others xenobiotics. |
| https://pubchem.ncbi.nlm.nih.gov/search/search.cgi | PubChem database provides information on the biological activities of small molecules. |
| http://www.ncbi.nlm.nih.gov/pubmed | PubMed database comprises biomedical literature from life science journals and online books. Some of the publications contained in PubMed database are free accessible. |
| http://www.proquest.com/products-ervices/biological_science.html | The Proquest database provides comprehensive coverage of biological science fields including journals, and conference papers, books, reports and other official publications. |

*Developing scientific research skills by use of scientific databases, visualization, mapping and analysis of the data*

The on-line biological databases are important resources for both teachers and students because they offer accurate scientific information and allow advanced studies in many branches of biology. The categories of databases include: sequences databases (for both DNA and protein), genomics databases, proteomics databases, 3D structure databases, mutation/polymorphism databases, metabolic pathways databases, scientific literature

databases, etc. A few examples of scientific databases that are accessible free online and are currently used in biology teaching and research are presented in Table 3.

Scientific research skills of students are also developed by teaching them how to access the databases containing scientific literature.

In this respect, a home assignment for students may be to find a number of scientific papers relating to a specified topic in biology research and to organize them such as to provide complete understanding of this topic.

## CONCLUSIONS

Internet resources make available many possibilities for teaching biology and training students in research activities. The use of internet resources provides students with fun and innovative ways of learning and allows teachers to benefit of the multiple styles of learning characteristics to the students.

Computers and internet resources cannot replace the other didactic tools and didactic materials. Also, their use must not substitute the activities meant to assure the community interactions, critically thinking and argumentation, debates, problem solving, development of interpersonal skills. More than it, students must learn to find and use other sources of information excepting the internet ones.

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