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A Virtual Enzyme-Linked Immunosorbent Assay (ELISA) Laboratory as a teaching tool for experimental work.

Ensayo virtual de laboratorio de inmunoabsorción ligada a enzimas (ELISA) como herramienta para la enseñanza del trabajo experimental.

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Abstract

This article describes the usefulness of the possible integration of the Virtual Enzyme-Linked Immunosorbent Assay (ELISA) Laboratory from the Howard Hughes Medical Institute (HHMI) into an undergraduate ELISA laboratory course. This Virtual Laboratory could enhance the traditional experimental work and could introduce the undergraduate students into modern biochemistry educational tools given the availability of the Internet.

Keywords. Immunosorbent assay, Virtual Laboratory, demonstration tools.

Resumen

Este articulo describe la utilidad de la posible integración del ensayo virtual de laboratorio de inmunoabsorción ligada a enzimas (ELISA) del Instituto Medico Howard Hughes (HHMI) en un curso de laboratorio de ELISA para pregrado. Este laboratorio virtual podría complementar el trabajo experimental tradicional e introducir a los estudiantes de pregrado en las herramientas educativas de la bioquímica moderna dadas las facilidades de la Internet.

Palabras Clave. Ensayo de inmunoabsorción, Laboratorio Virtual, herramientas de demostración.

Introduction

The incorporation of computer – based technologies into educational practices has increased tremendously in the past decade. As both software and Internet facilities become more accessible, their application in the undergraduate learning process becomes more widespread (Woodin and Rhodes, 2001), with noted improvement in student learning, particularly as regard computer assisted instruction or computer learning. Experimental work is an integral component of many courses in chemistry-biochemistry and laboratory exercises and requires a range of skills including manual dexterity and the correct use of equipment found in the laboratory. Laboratory courses are also very expensive to stage in materials and equipments. Thus a primary goal of many laboratory exercises is trying to teach students how to plan and conduct experiments. A typical laboratory exercise in chemistry of biomolecules is the Enzyme-Linked Immunosorbent Assay (ELISA) (Engvall and Perlmann, 1971; Van Weeman *et al*, 1971; Voller *et al*, 1978). The Howard Hughes Medical Institute (HHMI) (http: // www.hhmi.org/ grants /lectures/vlab1) -ELISA Assay demonstrates how a test termed enzyme-linked immunosorbent assay (ELISA), is carried out and some of the key experimental problems that may be encountered. Students could learn about the assay procedure and the equipment and materials that are needed. By completing this exercise, students might gain a better understanding and confidence of experimental design.This might be a very good supplement for the hands-on ELISA laboratory exercise.This article briefly describes this virtual ELISA laboratory from HHMI with the aim of seeing how this could be usefully incorporated into an undergraduate ELISA laboratory teaching course using the

Internet. This exersise is suitable for students with background in Biochemistry (Berg *et al*, 2002) and elementary Immunobiology (Janeway *et al*, 2001).

Description of equipment-materials

To run this practical teaching laboratory, little local infrastructure (a number of computers connected to the internet and equipped with a suitable browser program) would be required. The HHMI Virtual ELISA laboratory with Interactive Shockwave animations covers many concepts and potential experimental problems and the limitations of the test. This virtual laboratory demonstrates how this test is carried out, and laboratory protocol and individual steps are described in detail with an instructive way on web tutorial. Our future plan is to implement this virtual lab in our biological chemistry laboratory. We have already ask for permission from HHMI to use this resource for teaching before doing so.

In this virtual laboratory, students would be exposed to a sort of approach that the ordinary biochemists faces on the bench and learn how this technology is used in disease diagnosis. This virtual laboratory could be used to give practice with the planning of experimental strategy and to teach or consolidate basic theory.

In the experimental work at the bench, some commercial ELISA kits would be required. An automatic ELISA Analyser (CODA by Bio-Rad) (http://www.bio-rad.com/,accessed 2000) which is an integrated immunoassay analyzer intended for the automation of microplate based assays for in vitro diagnostic use, is also available in our Biological Chemistry Laboratory. All of the steps that are performed by the CODA Analyzer as part of an assay can be performed individually in the manual mode for manual procedures (for example plate wash, reading etc).

Procedure

First, in a class of 300 undergraduate students, the background theory (Figure 1) will be presented by the assistant professors (about two hours duration). Then, small groups of 5 students will be exposed to this new approach, virtual ELISA laboratory in the computer class (Figure 1).

Second, we will introduce our undergraduate students (small groups of 12 students) into our research labs where many traditional ELISA tests are carried out as part of mini-projects. So the students will see and will be exposed to the demanding experimental procedures at the bench. The objective of this is the understanding of the process of scientific enquiry and the practices of scientific research. Our postgraduate students and PhD students will help in this task.

In the accompanying wet laboratory exercise, 12 undergraduates all attempting to perform one commercial ELISA kit manually, might be convenient.

Finally, our students will have some experience with an Immunoassay Analyser, performing an assay in the automatic mode.

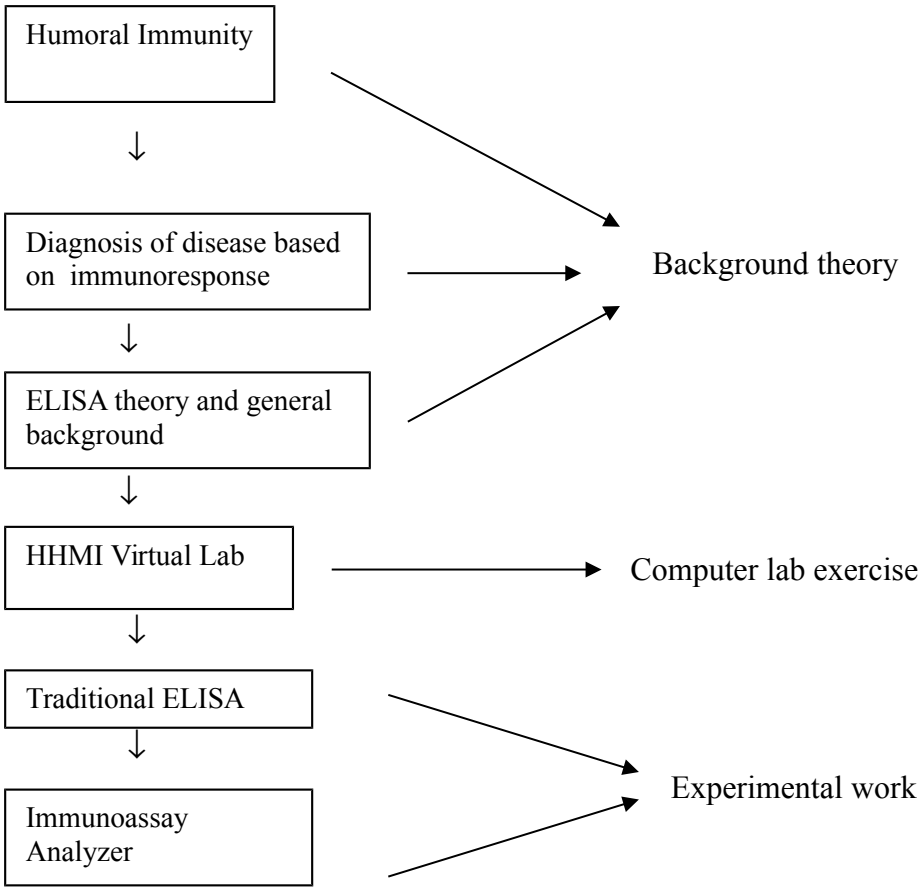

Fig.1. Representation of a flow of tasks (steps) that could be involved in an ELISA laboratory practical class

Results and Discussion

Report on experience from this virtual ELISA laboratory comes from our research laboratory. There is positive evidence from our postgraduate and PhD students. All students liked it. They found the HHMI ELISA- assay helpful and other virtual materials and web- based tutorials very useful.

The virtual ELISA laboratory when used in conjunction with the traditional laboratory, should be a particularly fine teaching tool, but cannot be a substitute for the laboratory work (Raineri, 2001) through which students learn and gain confidence in their laboratory technique. It is known that constrains of cost, time limits the scope of traditional laboratory work. Virtual labs can, at least in some respects, overcome these limitations, and their possible integration into a practical undergraduate teaching biological chemistry laboratory, must be taken into consideration.

Conclusion

We suggest that this virtual "dry laboratory" practical class, would be complementary to the traditional "wet laboratory" class. Another point of this article is to show the links between computer science and modern biological chemisty . It is surely a part of the education process to ensure that our students can make use of such resources on the internet. We should encourage the use of simulations, databases and web tools in general to construct learning environments where students could be able to engage in activities like those of practicing scientists and to familiarize them with resources available given the availability of the internet.

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