



# Metabolism with Flexibility

Marie-Paule Van Damme and Kaye Trembath

Department of Biochemistry and Molecular Biology, Monash University

Marie-paule.Vandamme@med.monash.edu.au

## Introduction

Biochemistry is a very broad and complex discipline, knowledge of which requires the ability to integrate a wide range of concepts. It is a challenge to teach students, especially in large classes, how to acquire this skill. This can be partly overcome using Computer Aided Programs which provide a highly flexible way to deliver difficult material and enable students to learn at their own pace, in their own time.

We have therefore developed a CD-ROM entitled *Biochemistry – A Metabolic Challenge* for teaching the principles of metabolism to a variety of university undergraduates including science, biomedical and medical students.

The package forms the basis of a non-traditional and very flexible approach to the acquisition and development of learning skills; it is used as the focus for both **Problem-Based Learning exercises** and **case study related Self-Directed Learning**, as well as being a resource for information, revision and self assessment. In a teaching sense, the package is utilised in different ways depending on the background knowledge of the students, the objectives of the particular course and the size of the class.

## Description of the CD-ROM

The CD-ROM contains two interactive problem solving exercises, namely “The Great Metabolic Race” and the “After Race Banquet”.

These exercises relate specifically to the catabolic metabolism associated with long distance running and the anabolic metabolism associated with the recovery phase. They test the students’ ability to integrate and understand concepts and pathways that are often learned in isolation. The exercises involve true/false questions, multiple choice questions, ‘click and drag’ questions and answers and calculations, the results of which are scored by the computer.

A series of quite extensive self-paced tutorials on various aspects of metabolism accompany and are linked to these exercises. The tutorials are also highly interactive, using animated demonstrations, ‘click and drag’ reaction sequences, ‘click and drag’ question and answers and multiple choice extension questions. The tutorials serve as an information resource and the information within them can be readily accessed through a comprehensive index of topics, even while undertaking the exercises.

For example, in one such question screen (Figure 1a), a student who is unsure about the pathways used by the muscle to produce acetyl-CoA for energy generation can obtain assistance from the tutorials using the Index link.

In this example, the student can click on “Muscle” in the Index, followed by “Pathways Utilised by” to find the required information as shown in Figure 1b. In this manner, students must think logically about how to find the information rather than being led directly to it using hyperlinks.

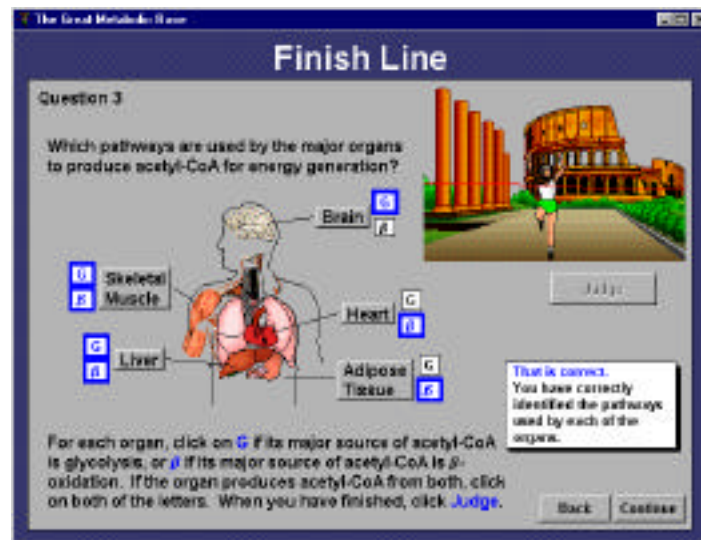


Figure 1a. A question screen from “The Great Metabolic Race” exercise

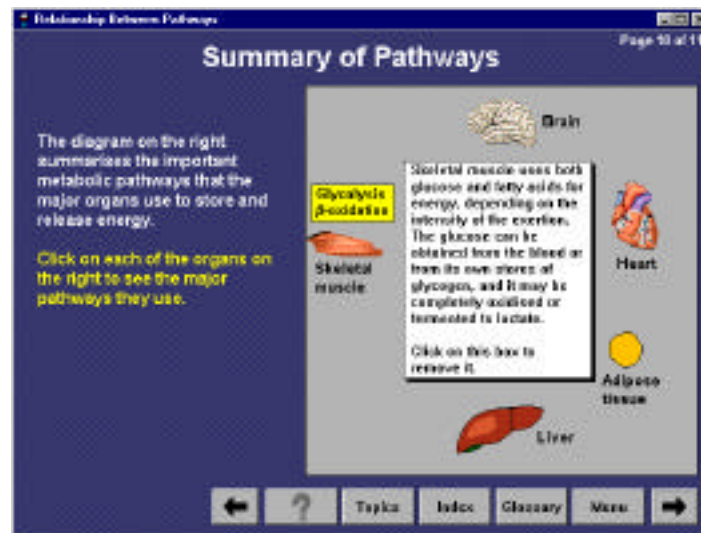


Figure 1b. Interactive information screen (from the “Relationship between Pathways” tutorial)

## Self-Directed Learning

In order to stimulate and challenge students we have adopted a much more self-directed learning (SDL) approach whereby students are expected to analyse problems, locate relevant source material and develop habits of independent study. Students receive a reduced core of basic lectures, supplemented with SDL tasks that are largely case study based.

Case studies are conducted in small tutorial groups (~10 students) which meet for approximately 3 hours. Students are expected to prepare for the tutorial in their own time and are responsible for the running of the tutorial. The tutors act merely as facilitators.

The case study on “The Metabolism of Alcohol” analyses the disturbance of liver metabolism due to the over-consumption of alcohol. Students should first review all the major metabolic pathways normally active in liver. Figure 2 identifies each of these pathways and has links to the tutorials (as shown by circled numbers) and to multiple choice questions with feedback answers.

As hinted at in Figure 2, the  $\text{NAD}^+/\text{NADH}$  ratio is sensitive to alcohol and students need to explore why this is so, and identify which of the pathways will be affected by changes in this ratio.

Only then can students begin to deduce the impact of excess alcohol on the liver. Computer programs are ideal for this type of investigation because they readily enable the visualisation of pathways and the relationship between them.

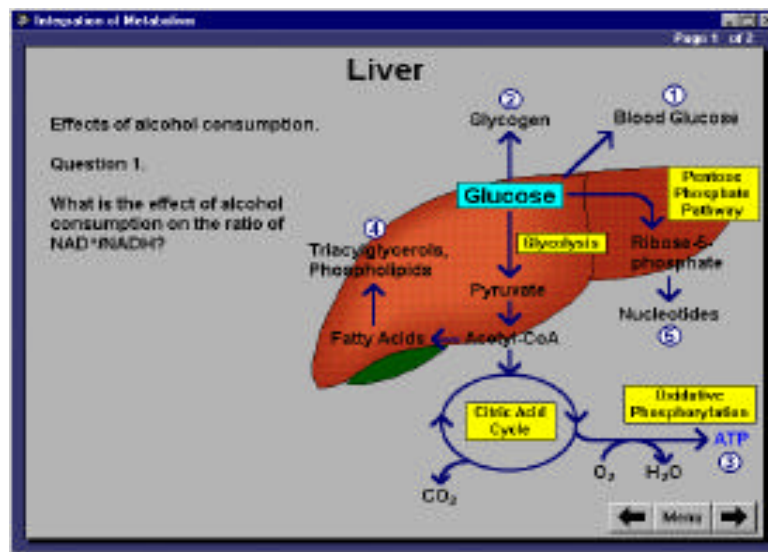


Figure 2. Major metabolic pathways occurring in liver

## Evaluation of the CD-ROM's educational value

Response to a survey conducted with science students (250) and medical students (160) indicated that 90% of the students gave a score of 4/5 or above in terms of improving their understanding of the subject. The same percentage of students preferred this Problem-Based Learning approach.

When an independent review of the package was conducted by Dr. L. Brown (University of Western Sydney), the following comments were made: "I believe the package to be an excellent aid to studying metabolism. It gives a visual dimension to what can be difficult conceptual ideas. ... In fact, I liked it so much I have ordered it myself" (see Note below).

A recent survey conducted with medical students who participated in the SDL sessions indicated that this mode of learning is preferable even though it is generally at least 2–3 times more time consuming for students. SDL is also more time consuming for staff as follow-up tutorials are conducted in small groups requiring several staff members to be conversant with the topics.

## Access to the computer programs

The package will be linked to a WWW site on Biochemistry, developed by A/P M. King, Terre Haute Centre for Medical Education, Indiana State University (<http://web.indstate.edu:80/thcme/mwking/lectures.html>). The package is also available on the Monash University Intranet.

## Acknowledgments

The programming and design of the package have been performed by Jonathan Gould. The authors would like to thank the Department of Biochemistry and Molecular Biology for financial support.

## Note

*Biochemistry – A Metabolic Challenge* was previously known as *Interactive Biochemistry – Metabolism* and the review of the software, conducted by Dr. L. Brown, was published in *UniServe Science News*, Vol. 12, March 1999, p19.