Science in the world of work

Each of the examples below illustrates a use of science in a different workplace.
Read through each and make notes below of how the use of science in each is different from the way it is learnt in school.

Example 1: Sports coach.

Anna is a sports medicine coach. As part of this work, Anna needs to monitor the performance of the individuals in the teams and supports their preparation for competition. These measurements include blood pressure, red and white blood counts and how rapidly lactate is removed from the blood.

Link to video about chemistry in sports

http://www.youtube.com/watch?v=MmXvYsnzZJE

Some biochemistry background

The body has a small store of energy, ATP, for exercise and all metabolic functions. Once this store has been used up, it needs to be reformed through ATP –PC (used for very short periods of time, up to 10s), anaerobic (for up to 50s) and aerobic (long lasting up to 5 min).

The ATP-PC is used for one high jump, a golf swing or a short fast sprint; the anaerobic system supplies energy for exercise lasting under 2 minutes, such as a 400m race; the aerobic system is the most efficient but the slowest at producing energy and requires oxygen and is used for longer periods of exercise.

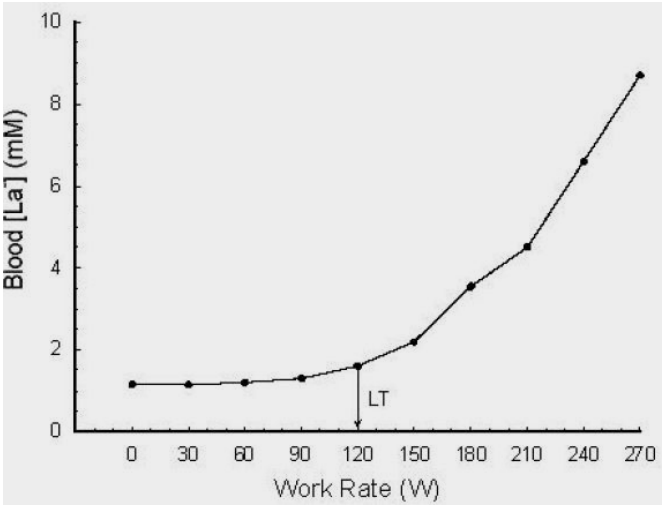
Lactate is produced by skeletal muscles as a result of anaerobic respiration. This way of respiring produces large amounts of ATP (energy for cells) but only for a short period. Lactate can accumulate in the muscles becoming too acidic for any further chemical reactions in the body, causing sudden 'cramp' when runners suddenly stop running towards the end of a 400m race. Lactate can be transported to the liver to be converted back to glucose or diffuses to other tissues preventing the build-up of acid in the muscles.

Figure 1 shows the relative proportions of aerobic and anaerobic respiration to produce ATP.

Duration of exercise	% Anaerobic	% Aerobic
1-3 sec	100	0
10 sec	90	10
30 sec	80	20
1 min	70	30
2 min	60	40
4 min	35	65
10 min	15	85
30 min	5	95
1 hour	2	98
2 hours	1	99

See http://exrx.net/ExInfo/EnergyGraphs.html

Figure 2 shows a typical response of blood lactate levels [L_a] to exercise. LT, lactate threshold, is the work rate above which the baseline [L_a] increases much more rapidly.

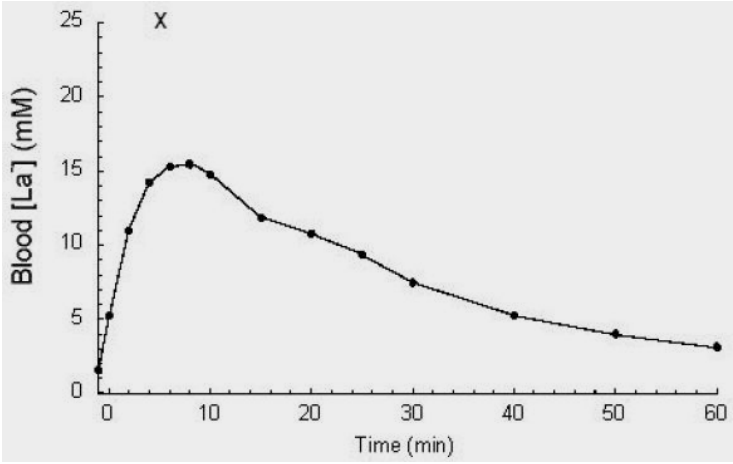


http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2769631/

For the 400m runners, where the anaerobic system provides the cellular energy for 30-40s, the lactate produced may cause runners to suddenly 'pull up'.

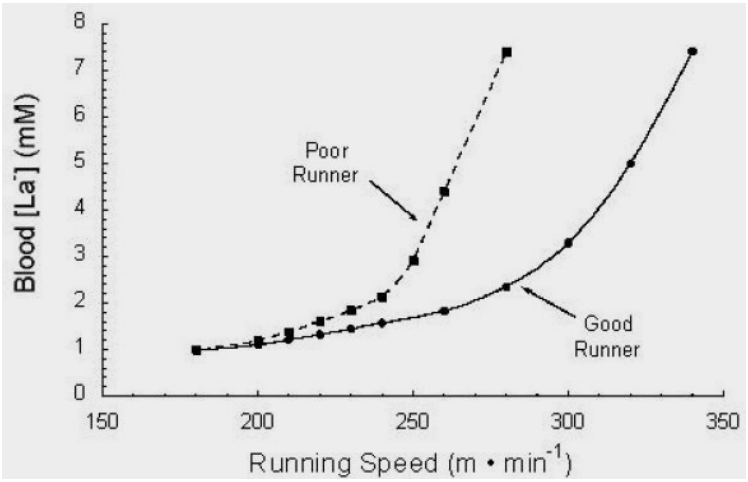
Can this threshold be altered as a result of training or is it inbuilt? Is LT a predictor of endurance athletes for 400m? How long does recovery take?

Figure 3 shows a typical response of blood lactate levels [L_a] to 60 s of exercise. Note that even though the exercise was of short duration, [L_a] peaks minutes after and the recovery period is much longer.



http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2769631/

Anna noticed that progressive incremental training over time, the runners were able to improve the LT and athletic performance over 400m.



So Anna has been better able to evaluate the suitability of a young athlete's potential and the effect of a training program at the athletics centre. LT needs to be increased if they are to be successful 400m runners, and an appropriate training program needs to account for the recovery time after each run.

Example 2: hospitality

Ben works in a local fast food restaurant. He didn't think that science came into his work!

Image from
http://www.mcdonalds.co.uk/ukhome/Aboutus/Newsroom/image_gallery/restaurants.html

For preparation for his work, Ben was asked to learn about the science of food preparation and storage, and first aid in the workplace. What sorts of guidance is he likely to be given about food preparation, storage and why?

One of the courses he attended was the use of an automated external defibrillator (AED), which can be used to restart the heart after a heart attack.

Video link to using an AED
http://www.youtube.com/watch?v=xfvu5FCQs6o

Example 3: leisure and gardens

Jacob works in a garden centre and looks after the roses. Jacob needs to ensure that the roses are free from greenfly (an insect pest that lives on bushes). There are 2000 rose bushes at the garden centre.

1. How could Jacob estimate the numbers of greenfly on all 2000 rose bushes?
2. Using a microscope, Jacob looks closely at one greenfly and determines the actual size. How will he do this?
3. The pesticides used to kill greenfly are kept in a locked room. Why is it important to keep these away from animals and people?
4. He has to dilute each (1:10) to be able to spray the rose bushes and makes up a 1L solution of 2 different pesticides.
5. What can Jacob do to find out which pesticide is more effective at killing the greenfly?