Toxicology and Ethics

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1. What is "ethics"?

Every human being has the ability to take decisions for which they must take responsibility. Ethics is the name given to our attempts to answer the following questions. What should I do in these circumstances? How should I use correctly my freedom to act?

There is often no simple answer to these questions. A human being can experience a challenge and respond to it in several ways. In each case, the problem is to decide which way is the best one. The choice made is not dependent only on the situation, but also on the influence of religious and other beliefs. Chemistry is a profession of many people all over the world, living in diverse cultural and religious situations. Finding solutions to problems posed by chemistry and its effects is influenced in many ways by these factors.

Toxicology is the study of the effects of substances which, depending on their dose, may be harmful to people, animals, plants and other living things, and ultimately to the Earth as an ecosystem. Sometimes toxic substances are applied to suppress or kill one species in favour of another one. The ethics of the person applying such substances determines this decision. It is perceived that a greater benefit (or a benefit which is thought to be greater) prevails over a lesser one or even over perceived harm. We kill bacteria because we want a person or an animal to stay alive. We apply fungicides on crops and fruits in order to be able to enjoy their consumption without risks. Some people are opposed to using fungicides because they regard the potential harm to the ecosystem to which they are applied as of greater importance than the benefits of more food for people or better human health. The ethical problem is not that there are

different, indeed opposite, replies to the same question, but that the judgements about what is the right thing to do are different. The judgements are culturally, religiously and personally biased. Thus, the aim of this short introduction to ethical problems is not to prescribe any simple answer for the questions stated in the first paragraph but to discuss the problems and indicate how answers may be reached.

2. Codes of conduct

A student of mine, Nico van Baren, has collected a number of codes of conduct or ethical rules, mostly self-imposed rules for of various groups of professionals (see Further Reading). In analysing these codes of conduct, he found he could distinguish three types of ethics. Firstly, there is the 'scientific standard', a set of professional norms applicable to scientific research. One of the widely used is formed by the CUDOS-rules, drafted by the American sociologist of science, Robert K. Merton. CUDOS means the following:

-communism (or, perhaps better, communality): every scientific discovery must be shared by the whole scientific world, as science can only progress if everybody is enabled to build further on the work of their predecessors.
-universalism: scientific truth must be independent of politics, religion, nationality, and gender.
-disinterestedness: scientists must not be led in their research by any possible personal interest they may have in the outcome of the investigation. Disinterestedness may also be translated as 'intellectual honesty'.
-organized scepticism: every finding must be critically judged by the scientific world, making it impossible for false or wrongly founded theories to persist.

A code of this kind is a scientific code.

Apart from scientific ethics there are also principles which can be described as social ethics. Such ethics are based on the view that every human being on this earth has a certain responsibility for the welfare of other people, and that people must behave correspondingly. Problems in this area arise because scientific knowledge empowers scientists to act in a way which can strongly influence their neighbours' lives. This power implies that scientists have greater responsibility than other people.

A third group of principles springs from environmental considerations. Again, this takes account of the scientist's special responsibility, not just for people in their environment but also for the quality of the environment (both now and in the future) and for the quality of life of all organisms on this earth.

3. An Example of a Code of Ethics for Toxicology

The American Society of Toxicology has evolved the following code of ethics:

Society of Toxicology Members shall:

**Strive to conduct their work and themselves with objectivity and integrity.*
**Hold as inviolable that credible science is fundamental to all toxicological research.*
**Seek to communicate information concerning health, safety, and toxicity in a timely and responsible manner, with due regard for the significance and credibility of the available data.*
**Present their scientific statements or endorsements with full disclosure of whether or not factual supportive data are available.*
**Abstain from professional judgements influenced by conflict of interest and, insofar as possible, avoid situations that imply a conflict of interest.*
**Observe the spirit, as well as, the letter of law, regulations, and ethical standards with regard to the welfare of humans and animals involved in their experimental procedures.*

**Practice high standards of occupational health and safety for the benefit of their co-workers and other personnel.*

It is clear that this Code implies scientific, social and environmental responsibilities. Taking this code of a learned society as an example, it should be feasible to explore what toxicology might imply for ethical rules applicable to teaching the subject.

4. Teaching of toxicology and ethics

For those teaching toxicology, a distinction must be made between the pure teaching and the handling of toxic substances in the process of education during demonstrations and labs.

The principal point of departure must be that no short-term or long-term harm should occur. Harm can be done to the teacher and the class, the school and its immediate environment, and to the environment as a whole.

In teaching, it must be made clear, both by example and in words, that substances can act as poisons, and that the utmost care must be maintained. In this respect, the directions to be found on labels are helpful in indicating the correct way of handling the chemicals to which they apply.

In handling, distinctions can be made between the situations occurring before, during and after the experiment.

Before: there is the consideration as to what substance should be used. If a less toxic substance can be substituted for a more toxic one to illustrate a point, the more toxic one should not be used. Dilution or aqueous solution may help to reduce possible toxic effects and may be helpful. Substances which are toxic in small quantities like sodium

cyanide should be kept away from students and be locked away. Substances which are considered as mutagenic, teratogenic or carcinogenic should not be used in educational institutes, unless safe handling can be guaranteed. Safety rules for the students, the school and the environment must be explained to the students and their written summary should be easily accessible to all concerned with handling of chemicals.

During any experiment: it is wise to consider if it is really necessary to have all the students carry out the experiment. A demonstration may be enough to show 'what the experiment is about'. In this respect, special attention may be paid to the trend to miniaturization which not only reduces greatly the amounts of chemicals to be used, but also diminishes the amount of waste to be disposed of. Miniaturization is feasible not only in sophisticated specially designed glassware, but in many cases also in simple equipment like racks of small tubes used in chromatography, simple porcelain plates with cavities, or even on overhead sheets. Using these is both ethically reasonable and cost-effective!

After the experiment: careful consideration must be given to safe disposal of the chemicals. In general, there are rules set by government which should be followed. If they do not exist, you should consult any good textbook on experiments which should indicate how to dispose of used chemicals.

In any case, thoughtful handling of substances is the simplest ethical consideration to be applied. Teachers are regarded as examples to their students and must behave in an exemplary manner in such matters. If the teacher sets a good example, the students will almost instinctively learn how to handle substances carefully and to act in the interests of all.

Further Reading

Nico van Baren, Beroepscodes in de wetenschappelijke wereld, Vrije Universiteit Amsterdam, Chemie en Samenleving 1990. (in Dutch).