Humane Education

Animals and Alternatives in Laboratory Classes. Aspects, Attitudes, and Implications

Helena Pedersen

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Introduction

The term *humane education* as applied in this study refers to non-harmful animal use or the use of non-animal methods in education and training. While many educational institutions nowadays are replacing animals as teaching and learning tools with alternative methods, dissection and vivisection is still the norm and often occurs as compulsory parts of the curricula that many students face during their education.

Humane education seeks to reduce the amount of suffering involved in teaching and learning and make use of alternatives; both for the sake of the individual students and animals involved, and for the general purpose of creating a culture of empathy and enhancing moral development in our relationship with other species.

The purpose of this study is to outline, analyse and discuss different perspectives on the use of animals in education versus animal-free, or humane, alternatives, and to suggest what steps should be taken in order to promote humane education methods. Various pedagogical aspects as well as the situation of the students and the animals are dealt with. Examples of practices, policies and arguments are given from various countries with an emphasis on Europe and the United States. The study is intended to raise awareness of the various problems related to the use of animals in education and to provide a basis for further discussion and research on the subject.

The manuscript was finished in November, 2000.

The Basic Facts

CHAPTER 1

Background

Definitions of Key Concepts

According to Merriam-Webster (2000), the word *humane* means 'marked by compassion, sympathy, or consideration for humans or animals'. Bearing this in mind, World Animal Net's (2000) definition of *humane education* seems to make sense: 'A process that encourages an understanding of the need for compassion and respect for people, animals and the environment and recognises the interdependence of all living things.' Traditionally, humane education has been defined as education about responsibility for companion animals. In the past decade, however, the definition of humane education has been expanded to encompass other animal issues, as well as environmental and human rights issues. (Weil, 1998) Consequently, the term is now often mentioned in connection with animal experimentation exercises. What is meant specifically by humane education in this context is a subjective matter, closely interlinked with the ethical standpoints of the individual. It does not necessarily refer exclusively to animal-free methods; many people may consider dead animals or animal tissue from a humane and ethical source (for example, animals which have died naturally or which have been humanely killed for other reasons), or waste materials from slaughterhouses and fisheries, acceptable to use in an educational setting.

While *dissection* refers to cutting up a dead/euthanised animal, *vivisection* is by Merriam-Webster defined as 'the cutting of or operation on a living animal usually for physiological or pathological investigation'; or (broadly): 'animal experimentation especially if considered to cause distress to the subject'.

The term *animal experiment* as applied in this study refers to a definition similar to that made by the Humane Society of the United States (HSUS, 1993): any procedure involving harm and/or death to the animal for educational or training purposes, such as animals being deprived of food or water to demonstrate behavioural conditioning, animals being injected with substances that alter their behaviour, or animals being killed to use their carcasses or tissue for various

demonstrations or exercises. (It should be noted that this definition differs from most legislative definitions, which commonly do not include experiments where animals have been killed for the purpose prior to the exercise. See also 'Legislative Framework' below.)

Throughout this study the expression *alternative methods* is frequently used. An alternative method can be a method which *replaces* another method, that is, gives the same information as the method being replaced (but without the use of animals), or a method that serves as a complement (*or* a substitute) to other methods in order to *reduce* the number of animals used. (NSMPD, 1993) The following groups of alternatives have been identified by the European Centre for the Validation of Alternative Methods (ECVAM, 1999):

1. models, mannequins and mechanical simulators;
2. films and interactive videos;
3. computer simulations and virtual reality systems;
4. self-experimentation and human studies;
5. plant experiments;
6. observational and field studies;
7. in vitro studies on cell lines;
8. clinical practice.

Added to the above list could be the two methods mentioned in the description of humane education in the beginning of this section (animals from an ethical source, and by-products from the food industry). An alternative method could also be to *refine* an existing procedure or technique so as to minimise the level of stress endured by the animal (OTA, 1988), or to simply *omit* a particular part of the curriculum. (NSMPD, 1993) (The concepts of replacement, reduction and refinement, the so-called *Three Rs*, will be developed further in chapter 3, section 'Alternative Methods'.)

Historical Overview

Experiments on live animals have been conducted for more than 2,000 years. When the city of Alexandria in Egypt took over from Athens the reputation of being the centre of science and education, dissection and vivisection with both animals and human beings as research tools were used. During this time there was also a lively vivisection debate, but unlike the one that is taking place today, its focus was not on the animals, but on human victims (slaves and criminals).

(Löfgren, 1979) The first recorded use of live animals was the study of body humours by Erasistratus in Alexandria in the third century B.C. (Orlans, 1993)

Before the 17th century, vivisection was carried out only by a few scientists and in few places. During the Renaissance, the interest in scholarship grew remarkably. Andreas Vesalius (1514–1564) conducted a number of experiments on monkeys, swine, and goats in order to study their anatomy. The 17th century saw the start of great scientific progress in areas such as medicine, physics, and chemistry. The experimental method was explored by, above all, Galileo Galilei (1564–1642) and Francis Bacon (1561–1626). Bacon heavily emphasised the importance of using live animals in research, especially in the field of medicine. (Löfgren, 1979) From the late 17th century through the 18th century, a strong tradition emerged in England and France of animal experimentation based on the notion that animals are incapable of feeling pain. The influential French philosopher René Descartes (1596–1650) likened animals to machines; according to this thinking, the cries of animals mean nothing more than the ticking of a clock. (Orlans, 1993)

The 18th century saw a stagnation in animal experimental research, but in the 19th century, these methods started to spread widely. As a part of the industrial revolution, more resources were devoted to research. There was an emergence of full-time researchers, and special laboratories for animal experimentation were established. (Löfgren, 1979) Two French physiologists, Francois Magendie (1783–1855) and his pupil Claude Bernard (1813–1878), revolutionised methods of scientific discovery by establishing live animal experimentation as common practice. This was also the time when the anti-vivisection movement, beginning in England, became formally organised. (Orlans, 1993)

Magendie established a private laboratory where he conducted research and ran a series of courses in experimental physiology for medical students and others who paid to observe his animal experiments. Magendie's research based on physiological experimentation was a radical departure from the previous approach of deductive inference from anatomy. In the vast majority of Magendie's experiments, there was no limit to the amount of animal pain inflicted since most of these were conducted before the discovery of anaesthetics in 1846. The procedures were also frequently repeated in public demonstrations. Magendie's highly invasive experiments carried out on dogs and other species, with purposes like investigating how the nervous system works and the absorption of poisons through various tissues of the body, caused so much animal suffering that during one of his demonstrations in London (1824), he was greeted with an angry public outcry.

This led to the first Parliamentary efforts to enact legislation in England to control animal experiments. (It would take 50 years until legislation was finally introduced.) Not only the public but also members of the scientific community, like the English anatomist Charles Bell (1774–1842), opposed the inhumanity of Magendie's work. In a debate on the morality of animal experimentation in the *London Medical Gazette* in 1839, the modern concept of alternatives was anticipated. (ibid.)

Magendie was succeeded by his pupil and assistant Bernard. In 1875 a remark by George Hoggan, who served four months as a research assistant to Bernard, appeared in the English newspaper the *Morning Post*:

> ... One of the most revolting features of the laboratory was the custom of giving an animal, on which the professor had completed the experiment, and which had still some life left, to the assistants to practice the finding of arteries, nerves, etc. (ibid., pp. 11–12)

Bernard was not met by the intensive criticism from the public and scientific community that Magendie had experienced. The reasons for this were that he was less insensitive to the moral issues than his predecessor had been, and also that the experimental techniques had improved so that, at least to some extent, the amount of animal suffering was reduced. Anaesthesia was beginning to be used, even though using anaesthesia did not necessarily mean painless experiments. (ibid.)

In 1860, the English physician Alfred Perry recounted in *The Lancet* what he had witnessed when he visited the Alfort Veterinary School near Paris in order to make some anatomical drawings. Students there practised surgery skills on conscious horses:

> Every week old and worn out horses and mules are provided, and the students of the two senior classes commenced, soon after nine in the morning with slighter operations of bleeding from the neck and feet, nicking the tail...etc. At midday...[they] proceeded to perform the more serious operations of firing, lithotomy, neurotomy [respectively, burning with a hot iron, removal of stones, and dissection or cutting of a nerve]... and other operations equally painful. This lasted till near five in the afternoon when the classes were dismissed, and the animals, if not already dead from pain and loss of blood were dragged into the yard and destroyed. (ibid., p. 17)

Perry tells how he remonstrated with the professor in charge who 'admitted the cruelty' but defended the practices because it 'accustomed the students to the shrinking of the animal when touched by the instruments; and it made them cool at operating'. In condemning these student experiments, Perry made the important distinction between experiments whose goal is to elucidate new physiological phenomena and those that were student exercises, or drill, to render the students

expert in the use of operating instruments. Perry called for abolition of these student exercises. He said they demoralised and brutalised the students. After protests the French Academy of Medicine was recommended to make a statement that henceforth veterinary students practise their skills on 'dead bodies, and no more on living horses'. This recommendation was defeated and instead, the Academy passed a resolution stating that the performance of vivisection and of surgical operations, as practised in the veterinary schools, should be left to the discretion of men of science. (ibid.)

The first English language manual for the physiological laboratory, *Handbook for the Physiologists*, appeared in 1873. The book was taken to presage widespread animal experimentation for educational purposes. It was met by considerable public protest, as many feared that unacceptable standards of animal experimentation were being fostered. For instance, it largely ignored mentioning the use of anaesthetics in many of the painful vertebrate experiments included in the book. (ibid.)

In the United Kingdom, policy recommendations concerning physiological experiments involving animals were drawn up in 1871, and in 1876, the Cruelty to Animals Act sanctioned animal experiments but required that animal pain be kept to a minimum. The law remained unchanged for 110 years. (In France, the first legislation controlling animal experiments was passed 1963.) (ibid.)

In the United States, most State anti-cruelty statutes were enacted prior to the 20th century, but the application of these statutes to laboratory animals is unclear. The Federal Laboratory Animal Welfare Act was passed in 1966. (OTA, 1988) Dissection was introduced into education in the 1920's as a way of studying anatomy biology, physiology, and the theory of evolution. (Physicians Committee for Responsible Medicine, 1996) In the period from the mid-1950's to the early 1970's, the United States focused on science education as a consequence of the 'space race' (an effect of the Russian launching of Sputnik which accelerated the scientific and educational competition between the countries). During this time frog dissection became the popular method to teach vertebrate anatomy. (AAVS, 1996)

Legislative Framework

The legislative situation regulating the use of animals in education differs widely from country to country. Most countries have no laws governing animal use in

education at all. (Balcombe, 1999) China, for example, has no controls, no laws, and no reporting of animal use in its schools. (Balcombe, 2000a) For those countries that do, most regulations only govern the use of live animals (although dissection of dead animals is more widespread). (Balcombe, 1999) A few countries have banned dissection below the university level. (Balcombe, 2000a) One of these, Israel, has recently banned animal experiments, including dissections, in the school system. (Watzman, 1999) Otherwise, most dissection-related regulations are local policies that permit students to use alternatives. (Balcombe, 1999) These will be dealt with in chapter 4, section 'Students' Rights'.

The European Union has the most far-reaching regulations on the use of live animals in education. (ibid.) In the *European Convention for the Protection of Vertebrate Animals Used for Experimental and Other Scientific Purposes*, the Council of Europe states that

> Procedures carried out for the purpose of education, training or further training of professionals... shall be restricted to those absolutely necessary for the purpose of the education or training concerned and shall be permitted only if their objective cannot be achieved by comparably effective audio-visual or any other suitable method. (Council of Europe, 1986, article 25)

There are national laws, like the Swedish Animal Welfare Act, that go further than the Convention in that they define animal experimentation as also including the killing of animals for dissection purposes. (NSMPD, 1993)

In Russia, there is no legislation restricting the use of laboratory animals, but in 1996, the Ministry of Education passed the first order concerning the use of animals in undergraduate education. It implies that animals used for invasive experiments have to be anaesthetised, and also abolishes the most cruel and painful experiments. (Maroueva, 1997)

In the United States, there are federal laws that affect the use of animals in education at the college level, but the use of animals in high schools is still largely unregulated. There is no nationally-accepted policy that sets a limit on harming or killing an animal for the purpose of education. Unlike the case in several European countries, there also is no legal requirement to demonstrate a level of competency (such as a bachelor's degree in the biological sciences) before animal experimentation is attempted. (Orlans, 1997) The Animal Welfare Act requires that each institution using animals is reviewed by an institutional oversight committee that assesses animal care, treatment, and practices. (OTA, 1988) Non-mammals such as amphibians, birds, fish, and reptiles, and also laboratory-bred rats and mice, are not covered by the Act (HSUS, 1997) although they include the most commonly

used species in education, which means that this law effectively excludes many educational institutions. (Orlans, 1997)

In other countries, like Sweden, there are ethical review committees which are to make a cost-benefit analysis (weighing the significance of the experiment against the expected amount of pain and suffering that will be inflicted on the animal) of all applications for carrying out animal experiments before they are approved.

CHAPTER 2

Facts on the Use of Animals in Education and Training

In What Educational Programmes and Courses Are Animals Used?

To give an exhaustive list of study programmes in various countries involving dissection or vivisection would not be possible, as such information requires that animal experiments are reported and registered. Such information is often insufficient or completely missing, or, if it exists at all, not available to the public. Instead, general examples must be given of study programmes in higher education where animals are typically used.

In study programmes for biomedical science, biological, medical, and veterinary education, animals are often used in a variety of procedures. (HSUS, 1986) Agronomists, pharmacists, and dentists are likely to have faced animal experiments during their education (NSMPD, 1997), and for animal technicians the experiments are an important part of their training. (ECVAM, 1999) Teacher training programmes (NSMPD, 1997) and psychology courses (Lewis, 1999) may also include animal experiments. In addition, a compilation of applications to the Swedish ethical review committees shows that in 1995 animal experiments were conducted in study programmes for, among others, physiotherapists, opticians, food chemists and some civil engineers, as well as in a few environmental study programmes.

Even art education can involve dissection exercises, like Cornell University's course of Physical Analysis of Movement in the Theatre Arts Department. (Wang, 2000)

In general, institutions training laboratory technicians, and veterinary and biology students use the largest number of animals, and laboratory classes studying anatomy, physiology and pharmacology have been identified as involving most animals. (ECVAM, 1999)

There are not necessarily any similarities between the animal experiments carried out in the same kind of study programmes, not even within the same country. In Swedish medical education in 1996, the various study programmes training physicians did not have even one type of animal experiment in common that occurred at all universities. (NSMPD, 1997) It is also often the case, as in medical and psychology education in the United States, that some departments use animals in their regular curriculum and some do not. (Hepner, 1994) At least in Sweden, omitting obligatory animal experiments from the curriculum seems to be more common in undergraduate education than in specialised courses of pharmacology, toxicology, zoophysiology, immunology, and so on. (NSMPD, 1993)

Statistics

Several countries publish data on animal use, although the amount of detail provided and the method of reporting varies widely. Although the European Commission has decided to take steps to make the number of vertebrate animals used for experimental purposes available, it is still impossible to determine accurately how many animals are used in education in the European Union. (ECVAM, 1999) According to the *Second report on the statistics on the number of animals used for experimental and other purposes in the member states of the European Union* (COM (99)191), the total number of animals used for experiments in the Community in 1996 was 11.6 million. (the European Commission, 1999) The overall picture that emerges from analysing available data is that approximately 1% (116,000) of animals used in science are used for education and training, but as procedures for registration of animal experiments are not standardised between countries, this figure may well be incorrect. In addition, the data available from some EU countries are not up-to-date, but may be several years old. This lack of accurate information does not facilitate defining a policy to reduce or replace the use of animals in education and to evaluate the effects of such a policy, as this requires reliable and comprehensive data. (ECVAM, 1999)

As mentioned above, the definition of an animal experiment in the Swedish animal welfare legislation includes animals that are killed without prior procedures, but no detailed information is available on the number of animals used for educational purposes according to this definition. Since 1990, Swedish statistics include more detailed information on the number of animals used according to the Council of Europe definition (which includes only living animals). Between

1990 and 1996, this figure has varied between 2,972 and 4,062 animals. In 1996, the number of animals used according to this definition was 3,411 (1,153 mice, 1,751 rats, 43 guinea pigs, 16 hamsters, 49 rabbits, 82 dogs, 308 pigs, 3 sheep, and 6 cattle). (StiFud, 1998)

As in the European Union, the data in the United States are unreliable, and the number of animals used can only be roughly approximated. (OTA, 1986) Balcombe (2000a) has estimated the total number of animals used yearly to close to ten million vertebrates and over ten million invertebrates.

The majority of educational institutions around the world use animals. Altogether, we can estimate that possibly over 100 million vertebrate animals are used for educational purposes each year. (Jukes, 2000) The number of invertebrate animals used is probably greater than the number of vertebrates. (Balcombe, 2000a) In 1984, an inventory of the use of animals in universities in the Netherlands was carried out by the Inter Universitair Overleg Diergebruik. The inventory found that the use of invertebrates was five times the number of vertebrates used. (Rivas, 1989)

The Purpose of the Animal Model

In education, animals are used as learning tools for achieving educational goals. They are used for demonstrations, illustration of facts and phenomena, for performing measurements (Nab, 1989) and for training various procedures. (Brennan, 1997) When animals – or alternatives – are used in education (or research, or testing), it can be because they are themselves the object of primary interest, or because they possess a simpler or more accessible structure or mechanism in comparison with the object of primary interest (which is often the human being), or because certain procedures cannot be carried out on humans.

Viewed from this perspective, both animals and alternatives stand as models. In the broadest sense, a biological model is a surrogate, or substitute, for any process or organism of ultimate interest to the investigator. It is a representation of or analogue to some living structure, organism, or process. (OTA, 1988)

Several characteristics are important in choosing a model for educational (as well as research and testing) purposes. The most important one is the model's discrimination – the extent to which it reproduces the particular property in which the investigator is interested. With greater discrimination, the predictability between the model and the property under study increases. After the discrimina-

tion, or predictability, of a model, certain other criteria stand out as being necessary for a good biological model. A model should, for instance, accurately reproduce the disease or lesion under study, be exportable from one laboratory to another, fit into available facilities of most laboratories, be capable of being handled by most investigators, possess certain anatomical, physiological, or behavioural attributes, be amenable to investigation with available techniques, and so on. Depending on the type and the needs of the investigation, certain of these criteria might be more important than others. (ibid.)

Examples of Species Used and Experiments Performed

In education, testing, and research, a small number of species have achieved prominence as experimental tools because they have been extensively studied from a number of perspectives and thus provide well understood paradigms that have been described in detail in terms of genetics, biochemistry, physiology, and other aspects. These organisms include, among vertebrate animals, the laboratory rat and the laboratory mouse. (OTA, 1988) From the European data currently available, it appears that the main species being used in biomedical education are – apart from rodents – fish and amphibians. (ECVAM, 1999)

To take medical education in the United States as an example, animals are used in many capacities, such as to illustrate the structure and function of the systems under study and the complex physiological interactions within a single organism. They function as intermediaries during a medical student's transition from trainee to practising physician, letting students cultivate their skills on other living creatures before they actually apply those same techniques to human patients. These techniques include venipuncture, insertion of catheters, and other procedure-oriented exercises. (OTA, 1988)

Rats and dogs are the principal species used in medical education in the United States, but in a survey conducted by OTA in 1983–84, several other species, such as primates, were also used. Nearly all small-animal use (i.e. rats, hamsters, and rabbits) is for microsurgery training like microvascular (blood vessel) suture techniques. Training in major surgery often involves the use of dogs, cats, or pigs. Ophthalmology departments use rabbits to teach the fundamentals of microsurgery of the eye.

Dogs and pigs are used to teach techniques for intubation (establishing an emergency airway) and the installation of intravenous/intra-arterial catheters.

Dogs can also be used for a number of other procedures, such as teaching insertion of catheters into the heart. (ibid.) Apart from surgical procedures, dogs are used for physiology and pharmacology demonstrations (so-called 'dog labs') (Orlans, 1993), where the purpose can be to see how certain drugs affect the body (the dog is anaesthetised, its chest sliced open, and the students will watch the reaction of its beating heart under the influence of various drugs). (PETA, 1999) A procedure where cats are generally used is the demonstration of infant endotracheal tubation to show the process of passing a tube into a new-born baby's throat to assist breathing. (Purnhagen, 1999)

In veterinary education, animals are used in various ways including the practising of terminal surgeries, creating and repairing bone fractures, and practising suturing, creating and closing a skin incision on live animals. (ibid.) Dogs, mice, rats, and birds are the most commonly used species in veterinary education in the United States. Other examples of species used include reptile, sheep, horse, goat, and cow. (OTA, 1988) In psychology education, different kinds of stimulus-response conditioning are demonstrated, using rats or pigeons. After the exercise, the animals are normally euthanised. (Purnhagen, 1999)

Isolated animal tissue is also commonly used in education. For instance, biology education in Sweden often includes nerve and muscle physiology experiments on frogs, where frogs are killed and dissected in order to use their muscles and nerves, which are then stimulated in various ways to demonstrate their way of working. Examples of other dissection exercises include the killing of rabbits or guinea pigs in order to use their intestines for studying how they are affected by various substances, the killing of rats to show biological oxidation in cells from the liver (StiFud, 1998), and the killing of rabbits to teach the students general anatomy (shapes, colour, and location of organs, etc.). (Tiger, 1990)

Dissection of frogs and other animals occurs also at lower educational levels in many countries in order to teach anatomy. Balcombe (2000a) identifies a number of commonly dissected species in the United States. These include (apart from frogs), cats, foetal pigs, rats, minks, pigeons, turtles, snakes, salamanders, bony fish (usually perch), dogfish sharks, lampreys, crayfish, locusts, earthworms, roundworms, clams, starfish, and barnacles. According to Orlans (1993), in the United States dissection is carried out even in elementary schools.

Live vertebrate animals are also used for experimental purposes by young students. In the United States, high school students have participated in so-called science fairs (high-school science competitions in which teenagers conduct extracurricular projects for monetary awards and prestige and exhibit the results) since

the 1940's. These science fairs have often involved vivisection. (ibid.) Typical science-fair projects have included administration of lethal doses of well-known poisons to small animals, and forced inhalation of cigarette smoke until the animals became sick or died. The fairs awarded prizes almost annually to teenagers who attempted monkey surgery (e.g. implanting brain electrodes or removing organs). Since then there has been some progress in ensuring that science fair projects in the United States are humane, but the new guidelines are not enforced nationally. (Orlans, 1995) Science fairs will be dealt with further in chapter 5, section 'Treatment of Animals in Education and Training'.

Alternative Methods

There seems to be a widely accepted view, also among members of the scientific community, that animal suffering should be avoided as far as possible when accomplishing the objectives of procedures in research, testing and education. From this view follows the ambition to reduce, refine and replace animal experiments whenever possible. The concept of these three steps, the 'Three Rs', had its origin in a project initiated in 1954 by the Universities Federation for Animal Welfare, which led to the publication in 1959 of *The Principles of Humane Experimental Technique* by W.M.S. Russell and R.L. Burch. Russell and Burch defined the terms as follows:

> *Reduction alternatives*: Methods for obtaining comparable levels of information from the use of fewer animals in scientific procedures, or for obtaining more information from the same number of animals.
>
> *Refinement alternatives*: Methods which alleviate or minimise potential pain, suffering and distress, and which enhance animal well-being.
>
> *Replacement alternatives*: Methods which permit a given purpose to be achieved without conducting experiments or other scientific procedures on animals.

Relatively little attention was paid to the Three Rs concept during the 1960's, but a number of significant developments took place during the 1970's, and the 1980's saw the introduction of a number of national and international laws and conventions with a Three Rs basis. These new laws and guidelines in various parts of the world not only recognised Russell and Burch's concept, but placed legal and moral obligations on all concerned, to seek to reduce, refine and/or replace laboratory animal procedures. But the Three Rs concept is still not universally

implemented. (Declaration of Bologna, 1999) Russell and Burch saw replacement as the ultimate goal for laboratory animal based research, education and testing, with the other two of the Three Rs, reduction and refinement, as interim steps toward this goal. (Balls, 1999) As mentioned in chapter 1, an alternative to an animal experiment in education can also be to *omit* that part of the curriculum; the animal experiment may simply be irrelevant to the area of study.

There is a wide range of animal-free models available for use in life-science education today. On p. 11, available alternatives were grouped together in ten categories. Here, three examples of alternatives from each of the categories 1–5 will be given, together with their area of application. These teaching aids are suitable for replacing traditional undergraduate animal experiments or complementing existing humane education. All information on the alternatives described is taken from Zinko, Jukes and Gericke (1997): *From Guinea Pig to Computer Mouse. Alternative methods for a humane education.* The purpose of the list of examples given here (by no means exhaustive), is to give an indication of the wide range of alternative methods available for educational purposes. Many more can be found in the book mentioned above (listing some 400 alternatives), other publications, and various databases.

1. Models, mannequins and mechanical simulators

a) Morphology: *The Great American Bullfrog*. A twice natural-size model, made of non-breakable, vinyl-plastic replica, includes a removable heart which divides into anterior and posterior halves. The mandible (lower bone in the jaw), tongue, and glottis can be removed for detailed study. Strategic cutaways reveal the bronchi of the lung, stomach, and the lumen (inside width) of the large intestine. Multi-level dissections expose the brain and nervous systems, the eye and optic nerve, and all of the bones of the skull and skeleton. More than 175 features are identified in the accompanying key.

b) Veterinary clinical cases: *Life/form CPR Dog.* Simulator designed to teach cardio-pulmonary (heart and lung) resuscitation in dogs; allows placement of endotracheal (windpipe) tube, practice in assisted breathing, cardiac massage, co-ordination of the respiratory cardiovascular (the circulatory system) functions.

c) Surgery: *Suture Practice Arm.* A model made of plastic with foam pad inside. Provides a tool for practising suturing and surgical knot tying. There are three wounds provided, and additional wounds can be cut at desirable depth or location. Each can be repeatedly sutured. The wounds can be bandaged with most standard adhesive bandages.

2. Films and interactive videos

a) Cardiovascular Physiology: *Physiology of Muscles and Nervous System: Part 3: The*

Heart of the Vertebrate; Blood Pump of the Circulation. A film showing the physiological characteristics of the heart of a frog. There is an accurate co-ordination of contraction of several parts of the heart, necessary for blood circulation. The film shows by means of experiments how each part has its own contraction frequency. (Can replace the common frog heart experiment, used to study various physiological properties, e.g. the automatism and the regulation of the heart activity.)

b) Behaviour: *Behaviour of the Rat.* An interactive videodisc. A tutorial guides the student through this database of video fragments showing different types of rat behaviours and gives information on backgrounds of behaviour and stress. The student learns by observing, exercising and answering questions.

c) Toxicology: *Water Deprivation – Sodium Ion Toxicity (Salt Poisoning in Swine).* A film showing clinical signs, pathology, and treatment.

3. Computer simulations and virtual reality systems

a) Metabolism: *Experiments in Metabolism*. A series of six computer programs that utilise colour graphics and animation to simulate experiments on the metabolism of the mouse. (Can replace the experiment O2-consumption in mammals where a mouse or a guinea pig is used.)

b) Pharmacology: *MAXSIM.* A computer program simulating drug absorption, distribution and elimination in detail.

c) Physiology – Acid-Base: *Arterial Blood Gases.* A computer program reviewing arterial blood gas values. One can select one of several patients and be led through the blood gas interpretation as the clinical course unfolds. The user makes clinical decisions on the basis of the blood gas values.

4. Self-experimentation and human studies

a) Digestion Physiology: *Measurement of gastric (stomach) secretion.* Students can measure their own gastric secretory activity by the use of nasogastric tubes (tubes passed through the nose into the stomach). Gastric secretion can be stimulated by insulin-induced hypoglycaemia (low concentration of glucose in the blood) or by pentagastrin, a synthetic gastrin (a hormone) analogue. The time-course of the secretory responses, i.e. volume, acid output, and pH are followed by collecting control and poststimulatory secretions into 15-min samples. The effect of antiulcer drugs (against gastric ulcers) can be easily studied.

b) Human Anatomy/Physiology: *Response of Blood Vessels to Cutaneous (Skin) Stimulation*. The physiological connection between sensory nerves and blood vessels is demonstrated. The reactive hyperaemia (excess blood) can be shown when removing cuffs and a pink flush spreads over the arm. The white reaction can then be shown, by stroking the flexor (muscle which makes a joint bend) aspect of the forearm with the end of a ruler five minutes after the pressure blocker is removed. The skin is immediately blanched, but some 15 seconds later a white line with sharp edges is seen where the stroke was made.

c) Pulmonary (Lung) Physiology: *Breath hydrogen testing (BHT).* A simple and reliable method for identifying impaired carbohydrate absorption. The students collect

fasting samples of expired air from each other using a simple nasal prong technique. They then drink one of several different aqueous carbohydrate solutions. Additional samples of expired air are collected by students at 90 and 120 min after substrate ingestion and are analysed by gas chromatography (a method of separating chemicals through a porous medium and analysing compounds). Students tabulate BHT results as well as recording any symptoms, using a standard scoring system.

5. Plant experiments

a) Nerve/Nerve-Muscle Physiology: *Intracellular conduction (transmission) of potentials with the alga Nitella.* The alga Nitella belongs to the Characea. Measuring the intracellular potentials is particularly easy because of the size of the cells. Action potentials are a thousand times slower than in a mammalian nerve cell. (Can replace nerve physiology experiments with frogs, with the purpose of studying nerve action potentials, demonstrating stimulus voltage/response relationship, and studying the refractory period; the short space of time after the ventricles of the heart have contracted.)

b) Cell Biology: *Biological respiration.* Mitochondria (parts of cells) are isolated from yeast. The mitochondria suspension can then be used to measure cell respiration either by measuring changes in gas volume or differences in oxygen concentration. (The experiment can replace the biological oxidation experiment where mitochondria are isolated from rat or mouse liver and a mitochondria suspension is prepared. The purpose of the experiment is to demonstrate different methods for cell respiration and to learn how to prepare biological material for measuring cell respiration.)

c) Cell Biology: *Electron transport chain.* Mitochondria are isolated from beet, potato or cauliflower. Parts of tissues are homogenised for a defined length of time, followed by filtration of the homogenate through muslin and the subsequent centrifugation of the filtrate at 4°C for 20 min. (Such experiments can replace the electron transport chain experiment, which uses mitochondria isolated from rat or guinea pig liver.)

Many alternative methods are very sophisticated. There are fake animals with gullets and stomachs, realistic weight and soft skins, as well as blood vessels through which artificial blood flows. (Okuno, 2000) A special type of model is a plastinated organ or whole animal. The animal is dissected to the desired stage and then penetrated entirely by silicon. Plastinated animals are preserved for unlimited time. Instead of killing an animal for this purpose it is possible to plastinate animals which have died of natural causes.

Modern computer software can provide, for instance, the function of biological variability, so that each time students must learn to interpret new results. (NSMPD, 1997) The new technology of virtual reality presents special opportunities. Virtual reality equipment allows all sensory input from the 'real world' to be

effectively cut off. The feeling of participation within the virtual world can be further enhanced by the use of gloves carrying sensors that analyse the position of the hands and fingers and in turn use this information to adjust the visual image. In another variation, the operator manipulates surgical instruments attached to a body simulator, while observing the results on a monitor. A feeling of physical resistance can be achieved by mechanical devices within the simulator, and the effects of operator actions can be displayed. (Smith et al., 1997) The School of Veterinary Medicine at Michigan State University, for example, is establishing a curriculum that relies heavily on virtual reality models.

Endotracheal intubation, ovariohysterectomy (surgical removal of ovary) and castration, intravenous catheterisation, and venipuncture are some of the procedures being transformed into virtual reality technology. (Thanki, 1998) Hagelin, Carlsson and Hau (2000) remark that ongoing improvements in technology suggest an important future role for virtual reality and simulation in surgical education and training.

Requirements for hands-on experience with real animals can also be met in a number of different ways that are fully humane. Animals which have died naturally, have been euthanised for medical reasons, or have been killed on roads or in pollution incidents are in some universities used for the study of anatomy and surgery. Orlans (1988a) suggests that anatomy can be taught by using animal parts from the supermarket meat counter, or that taking students on slaughterhouse visits can be a way to teach anatomical identification. As finding naturally dead animals can be a problem (unless co-operation with veterinary clinics and farms is established), this method may be a possibility, but it must be noted that the use of animal tissue from slaughterhouses or supermarkets is not an ethically acceptable alternative for all students. (The same goes for making use of surplus laboratory animals, which would have been killed anyway, or animals which have already been used in research; alternatives mentioned by Leivo and Salmi, 1994) Another disputable alternative is to replace an animal species (vertebrate) with another (invertebrate), the rationale here being that an animal lower on the evolutionary scale is believed to be less sentient.

For students requiring experience of live animals, clinical practice is a widespread, humane approach. Within some veterinary courses, for example, surgical skills are learned by students performing supervised castration and healing intervention at veterinary clinics. (Zinko, Jukes and Gericke, 1997) A similar practice is carried out in Finland, where students take their own pets to the university laboratory and subject them to a health inspection, monitor their blood pressure,

and so on. (Leivo and Salmi, 1994) Also anaesthesia and cardiovascular physiology can be studied by clinical practice: At some medical schools in the United States, students observe human cardiac anaesthesia in the operating room as a way to become acquainted with invasive haemodynamic monitoring, intubation, and cardiovascular drug effects. (Zinko, Jukes and Gericke, 1997) In the United Kingdom, live animals cannot be used by students practising ordinary surgery solely to improve manual dexterity and technique. Physicians there are trained by a process similar to apprenticeship, learning by observation, demonstration, and example. They assist an accomplished surgeon and expand their active role only as their abilities increase. (OTA, 1988)

Observing animals in their natural habitat is another alternative method suitable for psychology students, for instance. At Northeastern University in the United States a field project demonstrating the conditioning response of pigeons in a local park has been implemented. (Hepner, 1994) Such methods have the advantage of giving a more holistic picture of animals and the environment. (NSMPD, 1997) Other areas of study in which animals can be used in a non-invasive manner include zoology, anatomy, physiology, ethology, epidemiology and ecology. (EuroNICHE, 1997) Examples of procedures are simple genetics, observing reproductive behaviour, normal physiological processes of maturity, ageing, and death, disease processes, biological rhythms, and social interactions. (OTA, 1988) Well-designed observation projects can teach how to design a study; formulate hypotheses; collect, analyse, and present data; and draw conclusions. (HSUS, 1993)

Literature studies are sometimes used as an alternative method. In cases where the pedagogical aim simply is to gain information, this may be an acceptable alternative. In many other cases the aim is more complex and mere literature studies will not be a sufficient replacement, but may serve as a complement to other alternatives.

Perspectives on Humane Education and Animal Use

This section is intended to reflect various views on the use of the animal model and alternative teaching and learning methods in education and their impact on three main 'stakeholder' groups involved: Educators, students, and the animals used for these purposes. Arguments are expressed mainly through direct quotations, thereby giving a more accurate picture of the attitudes occurring in the debate as it is often possible to 'read between the lines' in the manner the arguments are formulated. The quotations often give an explanation of why a certain view is held, or illustrate a particular argument in a way that makes it easier to understand. Furthermore, one single quotation often expresses more than one argument, which is another reason why direct quotations facilitate reflection of the view held by the person quoted.

Each 'stakeholder' category is dealt with in a separate chapter, and each chapter raises a broad range of viewpoints and aspects. For instance the first section includes, in addition to arguments expressed by educators, issues such as educational objectives and quality, and implications for the future development of research. By focusing on one group at a time, variations in attitudes among members of the category are made visible, and the concluding discussion and analysis in chapter 6 is easily followed.

CHAPTER 3

Educational and Pedagogical Aspects

Conceptual Framework: Our Relationship to Knowledge and Learning. The Educational Theory of John Dewey

The experimentalist philosophy is built on a belief that an essential property of the power of reflective thought is the ability to predict events. The most adaptive and constructive qualities of such thought can be applied by the experimentalist to all areas of life which confront man with the necessity for control. Translated into educational terms, the learner is provided with a behavioural model whose predictive efficacy allows him to cope successfully with the environmental situation. (Roseman, 1992) The significance of the experimental method, or more specifically, the 'hands-on' experience, in science (and other) education, is often put forward as an argument by supporters of animal experimentation in education. The idea that human activity and practice is a prerequisite for gaining knowledge can be traced back to the American philosopher John Dewey (1859–1952), who has had a profound influence on both the theory and practice of, above all, American education, but also education in countries like Russia, Turkey, Iraq, India, Mexico, and China. (Kilpatrick, 1939)

Dewey began by conceiving of the individual learner as using his mind as an instrument to solve various problems presented by his environment, and he went on to develop a theory of education conceived as the growth of the learner. (Hofstadter, 1992) According to Dewey, the aim of schooling is the development of intelligence, and intelligence manifests itself in critical and creative thinking. The learner is required to proceed like a discoverer, and schools to provide conditions favouring 'learning in the sense of discovery'. The scientific method of problem solving as a method of teaching and learning is central to Dewey's theory of education. Knowledge and dispositions must be acquired from one's own experience. Dewey also recognises that a very important part of learning consists 'in *becoming* master of the methods which the experience of others has shown to be more efficient in like cases of getting knowledge'. General methods outline

recognised procedures and provide standpoints from which to carry out investigations. Study of these methods and results obtained from them in the past is quite essential and of constructive value to the learner. (Bhattacharyya, 1992)

To Dewey, the method of science is the prototype of all competent reflective thinking: 'Scientific method is a realisation of the most effective operation of intelligence'. However, he does not assume intelligence to be a single acquired skill or only the ability to use the method of problem solving, but recognises that intelligence includes many other capacities as well. In Dewey's view, practice and knowledge of rules are necessary factors for developing competence and proficiency, but must be guided by evaluative and innovative judgement. Intelligence is displayed more in the spontaneous exercise of judgement than in the knowledge of rules. (ibid.)

Judgement and intelligent action are thus the result of reflective thinking (which, in Dewey's view, must be an educational aim), and experience plays an important role in the achievement of this ability. The idea that better learning is taking place when the learner is actively participating in practising and experiencing in a broad sense, as a continuous investigator of the surrounding world, as well as in concrete situations such as laboratory exercises, is thus supported by Dewey and expressed by Hofstadter (1992) as knowledge being a form of action/practice (not subordinated to it), and action being one of the terms in which knowledge is acquired and used.

The significance of 'hands-on' practice is often emphasised, as mentioned in the beginning of this section, by those who promote the use of animals in education, but also by teachers who argue for the use of humane alternatives. Russell is an educator who belongs to the latter category. His view on pedagogy can be interpreted as supportive of Dewey's ideas of experience and practice as central elements in the learning process:

> As a long-standing university instructor I strongly endorse the need to provide meaningful laboratory experiences for undergraduate students (and others), and several basic principles of pedagogy lie at heart of this commitment. Students learn best from 'hands-on' experience and the opportunity to work directly with biological materials. 'Learning by doing' is a principle each of us knows from life experience. True inquiry-based laboratory study gives students an understanding of the scientific process and serves to enrich the more didactic material of the classroom or lecture hall. But 'hands-on' laboratory work and inquiry-based studies do not imply the absolute need for invasive studies and vivisection. I will argue vigorously that students can have meaningful laboratory experiences with the wide range of humane alternatives that exist or can be developed by an imaginative teacher. (Russell, 1999 p. 4)

Krause (1980) has made an interpretation of Dewey's theory where he focuses on another perspective. Referring to Dewey's *Democracy and Education* of 1916, he finds that an important educational objective is intrinsic in the title. In this work, where one of the two major tasks of education is defined as to create social beings, Krause also sees that the idea of reverence for life is implicit, and concludes that a respect and love for all creatures should be a minimal goal of public educational systems.

Educational Goals and Objectives

In addition to more general educational aims, laboratory practical classes have their own specific objectives that must be achieved. Brennan (1997) summarises the relation between educational goals and the 'hands-on' approach, as introduced in the previous section, by applying Bertrand Russell's distinction between *acquaintance* (the immediate knowledge we have of something before our mind) and *description* (the knowledge we have of something beyond our experience). Brennan states that education can properly aim to give us both kinds of knowledge, often in combination, which is the case with much of the practical work in the sciences.

In order to convey both types of knowledge, higher education courses in the sciences typically use a variety of teaching and learning approaches, for example, lectures, seminars, tutorials, self-directed study and practical laboratory classes. As previously mentioned, in some subjects, many laboratory classes involve the use of animals and animal tissue. *The European Convention for the Protection of Vertebrate Animals Used for Experimental and Other Scientific Purposes* states clearly that animal experiments in education and training shall be carried out only when the experiment is absolutely necessary for the purpose of the education (see p. 14 ff), but a problem here is that the objectives of the classes where animals are used are not always well defined. (ECVAM, 1999) In general, educational goals of animal experiments in higher education can be summarised as follows:

- Support in obtaining *factual knowledge*. (Names of anatomical parts, histology of muscles and nerves, location of organs, and so on)
- Illustration or demonstration of *dynamic processes*. (Especially those processes that cannot be shown by static means, such as the contraction of the heart muscle and how different parts of the heart work together.)
- Demonstration of the *integration of complex systems*. (Such as the influence of the hormonal system on the regulation of blood pressure)

- Acquisition of *methods of scientific research*. (How to design an animal experiment, use statistics, work up experimental data, create reliable experimental conditions, etc.)
- Developing *problem-solving capabilities*. (Learning to make decisions in an experimental environment)
- Stimulation of *independent working*.
- Acquisition of *manual skills*. (Preparation of the animal for the experiment, dissection, injection techniques, handling, bloodsampling, etc.)
- Developing *attitudes* toward animal experimentation.

(Nab, 1989)

Regarding biology education in secondary school, the educational goals look different. Hepner (1994) mentions the following aims:

- To instil in students an appreciation for the diversity of life.
- To provide a general overview regarding basic biological concepts that create understanding or that can be expanded upon in later courses.
- To spark students' interest in biology.
- To develop thinking skills and inquiry skills.
- To give students an understanding of the scientific method and how it relates to problem solving.

Any alternative should fulfil the above objectives at least as well as the traditional approach. To find out about the effectiveness of an alternative model, like that of any other new model in science, the non-animal educational tool has to be evaluated before being introduced on a broader scale. One way to evaluate a non-animal model is to compare it with the animal model that it replaces. This has been done with several alternatives. In general, the results have been that students who used the non-animal models performed as well as those who used the animal model, or even better. (ECVAM, 1999) This is shown by a compilation of comparative studies of dissection and other animal uses in education published by the HSUS (1999). Out of 29 evaluation studies comparing learning outcomes of students using traditional approaches with students using alternative methods, 16 showed that the performance of the two groups were equivalent; 12 found that the students using alternative methods performed better; and only one study found better performance with the students using traditional animal models. (Studies of both high school and university students in a variety of disciplines are included in the compilation.) Another study pointing at the advantages of animal experiments

demonstrated that medical students using a virtual reality-based module for intravenous catheter placement showed improvement in the virtual environment but were unable to transfer the skill to physical reality. (Hagelin, Carlsson and Hau, 2000)

That educational goals can well be fulfilled without the use of animals is also indicated, as mentioned in chapter 2, by the inconsistency of the use of animal experiments found within the same kinds of study programmes at different institutions. To take another example, according to several surveys in the United States, approximately half of the psychology departments surveyed used animals in the curriculum, whereas a survey carried out in 1987 showed that a great number of American medical schools do not use animals in their curriculum. (Hepner, 1994) Again, this situation makes it desirable that the objectives of the practical class where animals are used are clearly defined and linked to the educational goals in the curriculum. Only in this case will it be possible to justify the animal model.

There are a number of problems connected with the evaluation of alternative models. Most evaluation studies that have been carried out can be criticised for emphasising students' 'content' knowledge (memorisation abilities) rather than 'process' skills (abilities to design and perform experiments and analyse data). (Balcombe, 2000b) Furthermore, depending on the learning objective, an animal experiment may not be replaced by one single alternative, but by a combination of two or more. (NSMPD, 1997) This can make it difficult to assess each model separately in direct comparison. The success of a practical class also depends on other factors than the model itself, for example, the way it is being applied, whether it is for self-study or a tutored class, and the level of involvement of the tutor in introducing and summarising the findings.

In addition, the attitude of the lecturer often determines the success of a practical class. When an alternative model is introduced with a lot of scepticism, the success rate of the model tends to be low, whereas if the lecturer is positive and enthusiastic, the chance of success is much greater. Bringing new technology into the classroom as educational tools may require a different level of technical support and the adoption of new learning styles, which could have major consequences for the curriculum. Quality of the software, requirements that the hardware fit into the learning environment, and sufficient training of teachers are other factors necessary to consider when introducing a new model. (ECVAM, 1999)

Having suggested that many educational objectives can be achieved without using animals, the question arises whether there are any objectives which really

require animal models. In an investigation into the issue of conscientious objection, the Swedish Ministry of Education has identified veterinary education as a study programme where animal experiments must constitute an obligatory part. The investigation also stresses that animals that already are sick or injured are not many enough to meet the educational needs. (Utbildningsdepartementet, 1994) This argument is refuted by the Association of Veterinarians for Animal Rights (A.V.A.R.), which claims that veterinary medical students can be trained to perform surgery, for example, without using 'practice' animals, as the emphasis in training is on principles rather than specific procedures. What A.V.A.R. recommends is a procedure similar to that of training physicians in the United Kingdom (see 'Alternative Methods' in chapter 2): After having developed basic manual dexterity on inanimate objects and having furthered their skills by using cadavers of animals that died or were killed for medical reasons, the students then, during their clinical training period, begin carrying out supervised surgery on clients' animals; gradually increasing their level of involvement as their skill improves. If necessary, the clinical part of the programme should be increased in order to obtain enough case material. (Hepner, 1994) The problem with this approach may be a lack of standardisation of techniques taught, and a potential lack of adequate assessment of technical skills achieved. (Hagelin, Carlsson and Hau, 2000)

Microsurgery training presents a particular problem. Apprenticeships work well for practising most types of surgery but are ill-suited for this particular field. Used primarily to reconnect severed fingers or hands or to reconstruct badly damaged tissue, microsurgery involves, among other things, reconnecting tiny blood vessels. It is not the sort of operation a trainee can readily learn at the shoulder of an accomplished microsurgeon. A British plastic surgeon has developed an alternative to animals using human placentas. The surface has blood vessels of various sizes that can provide opportunities to practise microsurgery. A pump simulates blood flow through the vessels. A problem with this model is that the pumped blood cannot clot. Since learning how to avoid clotting is a critical aspect of microsurgical training, and since students training on placental tissue cannot detect their errors that cause clotting, the system is at present not fully adequate unless this limitation can be overcome. (HSUS, 1986)

Courses in laboratory animal science, which prepare students specifically for future scientific work using animals, must also be discussed in this context. Apart from laboratory animal handling skills, these students must, for example, gain certain problem-solving skills which make them able to identify, explain or correct

the unexpected aberrant responses which develop during any biological experiment. (Watt, 1989) Also in this case, learning should occur as far as possible by closely supervised apprenticeship in the research laboratory. (ECVAM, 1999)

From a strict learning objective perspective, laboratory animal science is perhaps the only area of education where the animal model as an educational tool may be justifiable, but this education could be designed as supplementary courses at an appropriate level rather than being an obligatory part of a study programme. (NSMPD, 1997) The majority of students taking part in animal experiments today will obviously not enter a future profession where they will be involved in the design and conduct of animal experiments. This is especially true for students in secondary school and at lower levels, but also for most university students.

One of the above-mentioned learning objectives, development of an attitude to scientific research methods, is of particular importance. It will be dealt with both in the following section and in the section 'Implications for Educational and Professional Development', below.

The Hidden Curriculum: Implicit Messages of Animal Experimentation

When considering whether an alternative method can fulfil the same educational goals as an animal model, it should be taken into account that the use of animals as an educational tool may have additional consequences for the students and the learning environment. Such consequences include, as mentioned, the shaping of attitudes to various research methods, and the risk of desensitising students to animal suffering. Both these issues will be dealt with in turn.

The sensitive issue that science education influences the development of students' attitudes to future choices of research methods, is illustrated by the following two quotations:

> Alternatives must satisfy the demands of science education, teaching both the scientific method and the fundamental skills and techniques necessary to carry out scientific investigation. Yet science education does more – as it trains aspiring students, it establishes a framework of values and molds attitudes that will long influence their work. Therefore, exposure to alternatives, particularly the concepts underlying animal use and alternative methods, strongly influences the paths investigators choose to follow in the future. Viewed from this perspective, the acceptance (or rejection) of a specific alternative method in education assumes an importance that is, in fact, secondary to the impact it may have on the development of a student's overall attitude toward animal use

> in research, testing, or education. (OTA, 1988 p. 208)
>
> I thought about what we can do when students refuse to take part in animal labs and more importantly, what we can do that will prevent or reverse antiscientific opinions in our students, for often their opinions are inconsistent and not based on reasoned discussion. ... Our special opportunity arises from physiology being quintessentially an experimental science. Physiological knowledge is often derived from animal experimentation. Herein lies our responsibility: we must convince our students that the future development of physiology depends on the use of animals. If teachers do not come to grips with this responsibility, students will not have the motivation or confidence to take the lead in shaping public opinion. (Hansen, 1993 p. 1)

The concern about nurturing biased and uncritical thinking among students in this respect is confirmed by studies showing that students tend to gain an affinity for whatever learning methods they are exposed to. (Balcombe, 2000a) This issue is modified by Cervinka (1994), in saying that the introduction of restrictions by the faculty to reduce the number of animals used does not in itself change students' attitudes, but should be followed by other approaches towards a humane education as well.

The contradictory message that science students receive as a result of using animals as educational tools – in order to study life the animal must be killed – has been put forward by many who object to dissection and vivisection in education. Already in 1860, the English physician Alfred Perry mentioned demoralisation as an argument for the abolition of animal experiments in education (see chapter 1), and in the mid-70's, a number of biology students at Stockholm University who reacted to the obligatory animal experiments in the biology programme published a call for debate on the issue in the internal university newsletter. Questions asked were:

> Shouldn't we, as good biologists, have respect for life in all its diversity, and shouldn't we, already at the basic levels of study, show this respect? Is it an educational aim that we, as students, should be desensitised and learn uncritically to accept animal experiments as a method of analysis and study, without reflecting on alternative experimental methods? (Löfgren, 1979 p. 95, author's translation)

The concern about desensitisation is based on the risk that students' ability to feel compassion for other living beings may be harmed by performing animal experiments. A desensitised person is either unaware of the animal's suffering, does not care about it, denies its existence, or believes that such suffering is warranted by the importance of the work. (Balcombe, 2000a) There are also indications that a desensitised attitude towards animals, in a broad sense, may extend to include humans also (but probably more complex factors are at work when this connection is established). (Hepner, 1994) The International Association Against Painful

Experiments on Animals gives an example from *British Medical Journal* in 1983, where it is reported that Canadian neurologists who had spent a year of their training experimenting on animals, were incapable of recognising suffering in their patients for quite a while after returning to clinical work. (IAAPEA, 1998) Another example of the desensitisation process is a study included in a compilation by the HSUS. The study, published in the *Journal of Contemporary Ethnography* in 1996, shows that medical students initially felt moral uneasiness towards performing terminal procedures on live dogs during a so-called 'dog lab', but eventually were able to neutralise their feelings of moral guilt by developing moral 'absolutions', or reassurances, that permitted them to deny responsibility and wrongdoing. (HSUS, 1998a) According to Balcombe (2000a), some science teachers even admit that one of their aims is to desensitise students, in order to convey attitudes appropriate for a good scientist (such as rationality and unsentimental behaviour).

It is believed by some that the younger the student is when participating in animal experimentation exercises, the greater the probable impact on the student's emotions and attitude. The first animal experiment many students face at school is a dissection exercise. Dissection in schools is heavily criticised by Breslin (1996) for being a 'rite-of-passage', aiming at preparing the student for more invasive procedures using live animals at higher educational levels as the student gradually gets used to handling the animals as non-sentient objects. This view is shared by Solot and Arluke (1997), who, in their field study of American sixth graders during dissection classes, have found that middle-school biology dissection serves as the start of a socialisation process of young students into the scientific community, and that for some students dissecting is a 'trial' that will determine their preparedness for upper-level science classes or even medical school.

In the same study, Solot and Arluke observed a number of different reactions connected to desensitisation that are evoked among the students by dissection exercises. Solot and Arluke denote these mechanisms *emotion management strategies*, developed by students to enable them to cope with the dissection situation. These strategies include objectification of the animals, accentuating the positive side of the dissection experience, assuming gender-stereotypical behaviour, and using humour, and each of these strategies will be dealt with in turn.

1) *Objectification.* Solot and Arluke have found that most students feel more or less uncomfortable when facing a dissection situation because they are making physical contact with animals in ways they would usually define as inappropriate. A

common solution to this problem is to mentally transform the animal into a specimen; something entirely different from the contacts they have with animals in their personal lives. By doing this, students see the animal as a set of esoteric body parts and see the purpose of their contact as a mechanical or analytical problem. This objectification, or de-animalisation, starts early in the dissection procedure; prior to making the initial incision that cuts open the animal's body. This initial incision frequently seems to be the hardest one for students to make. Once the body is open, the signs of 'animal', such as fur or eyes, disappear behind the newly revealed innards. Solot and Arluke also state that considering the tendency to anthropomorphise and identify with animals' 'humaneness', the incision into an animal body may be said to have a dehumanising effect along with a de-animalising one.

2) *Accentuating the positive*. In spite of initial ambivalence towards dissection, the dissection situation often gives the students opportunities to feel proud about what they are doing, seeing it as an important step toward becoming a physician, or feeling proud because they managed to go through this experience. This is sometimes reinforced by the school. At one school there was an officially sanctioned tradition for students who have dissected to carry their dissected earthworms to other classrooms to display their work to the younger students. Another example is that during one dissection, the school photographer circulated around the classroom taking photos that documented the event very much the way other rites of passages, such as birthdays or graduation, are documented. In these ways, dissection becomes culturally important. The message of the importance of science also existed in the fact that students were frequently excused from their other classes to complete dissection periods. Positive feedback for incision technique and organ beauty from the teacher also helped students tune in and begin to enjoy the cutting and organ inspection.

3) *Gender-stereotypical behaviour*. Initially, the emotions displayed by both boys and girls in the classroom were in keeping with gender stereotypical behaviour. A lot of girls think dissection is 'gross', girls get sick, girls use words like 'cute' to describe their specimens, and girls ask not to dissect. Boys, on the other hand, act as if excited to dissect and thinking it is fun and cool to do. Boys use expressions like 'dig into' their specimen, have races to see who could 'dig out' the eyeball of the animal fastest, carry body parts around the room to show other people, and are generally 'wild'. One class that was observed had an odd number of students, and

the boy in the class who eagerly volunteered to dissect without a partner seemed highly regarded by his male peers. These observations suggest that some boys' interactions with their specimens had an added element of display at work – a performance for other people, notably for other boys. This can be described as a dominionistic attitude in which interaction with animals provides opportunities for the display of, for example, strength and masculinity. Attachment or sentimentality toward the animals was denied or avoided by many of the boys. Over the dissection exercise, girls increasingly followed suit, appearing to become less sentimental.

4) *Using humour*. Joking and disrespectful behaviour can be seen as an expression of discomfort with the dissection situation, or as a way of letting other students know that they are not alone with the problem. In this study, the first type of humour involved comical naming of the specimens, such as 'Miss Piggy' (the students dissected foetal pigs), but without using the names in a serious and consistent manner. A second type of humour involved students playing with their specimens in ways they defined as funny or entertaining. Examples of such behaviour include a boy who danced his foetal pig around roughly, making up 'Rubber Piggy' lyrics; another boy who held up his pig in a plastic bag and announced, '$19.99', as if it were for sale; a third boy who made his pig struggle for freedom from the pins holding it down; and a girl who stuck her finger in her pig's mouth and screamed as if it was eating her finger.

Especially at the end of the dissection when students correctly perceived that what remained of the bodies was useless waste, their play with the pigs was more mutilating. Two girls repeatedly filled a removed pig stomach with water, squirted it out and laughed; a boy whistled a death march as he carried his pig to the garbage can, dissection tools plunged through its head and body like the victim of a gruesome stabbing; a boy and girl in another class were repeatedly denied permission from the teacher to cut off their specimens' heads – both did so anyway at the end of the dissection, proudly parading the decapitated heads around the room; boys evoked squeals from girls by dangling organs in front of them; and one girl brought a sample of pig brains into the hall to 'gross out' the nondissectors.

Solot and Arluke refer to other studies which have shown behaviour similar to several of the above reactions occurring among students at university level and researchers.

In their study, Solot and Arluke also found authoritative behaviour as part of

the socialisation process of the students into the scientific community. In traditional schools, authority and the power that comes with it reside with the teachers and administration; students fall clearly at the powerless end of the hierarchy. During a dissection, however, the teacher hands out some of her or his authority to the student, who in turn projects it over the animal. Dissection is one of the few situations in school in which students are given a great deal of authority over another being or body. The process of gaining power increases with the students' confidence; the more comfortable they feel during the dissection, the more aggressively they cut and handle the specimen. But, a student who opts to sit in the hallway and perform an alternative assignment from a textbook remains in an unaltered, non-authoritative student position.

Socialisation and desensitisation processes, in their variety of expressions in the school or university laboratories, can be placed in an educational theory context, using Solot and Arluke's distinction between *manifest* curriculum and *latent* curriculum; the manifest curriculum expressing concrete educational objectives such as knowledge of anatomy or handling skills, whereas the much more subtle latent curriculum may include an experience by the students of a change in their status and rights. Brennan (1997) has a similar approach in his analysis, where he uses the terms *overt* and *hidden* curriculum. Like Solot and Arluke's definition of the manifest curriculum, the overt curriculum is explained by Brennan as the one published in course handouts, shown in the university calendar, and revealed in the official reading lists. The hidden curriculum is defined by Brennan as one that may be inferred from, for example, the quality of interaction between teacher and student. However unbiased the overt curriculum is, the human dimension of the relationship between the instructor and the student can convey numerous signals, values and attitudes that are entirely absent from the written curriculum materials.

When it comes to work with animals, Brennan emphasises the importance of the attitude the teacher reveals through his or her approach to the situation. Is there a discussion of the ethics of animal use? What attitude is taken to those students who express discomfort or unease about the use of animals? How is the living or dead animal handled? The hidden curriculum is an important part of the student's educational experience and in many cases, the influence of the hidden curriculum will be retained long after the things taught in the overt one is forgotten. Solot and Arluke (1997) recognise that it may be a difficult task for educators who support dissection to strike the right balance between the two contradictory messages that they try to get across to their students: On the one hand to demonstrate interest and respect for what they are doing, and on the other

hand wanting students to 'separate their tender feeling for animals' from their need to do research with animals.

Russell (1999) suggests that to prevent conveying the implicit message to the student that ethical concerns do not count or matter, and that procedures employed in their laboratory courses are fully justifiable because the procedure is 'scientific', the ethical context must be fully integrated into the programme of study at several levels, and questions of ethics must be considered regularly. ECVAM (1999) goes further in recommending that students should always be offered the choice of alternatives and also be required to justify their decision if they decide that the experience offered by an animal experiment is essential.

Quality of Education

In recent years, there has been an increasing concern for quality in education, a concern based primarily on an awareness that educational institutions must be accountable in various ways to society, to employers, to students, and to each other. (Frazer, 1994)

The concept of quality, as described by Green (1994), is elusive and complex. There are many possible approaches and definitions of quality in education, depending on the values and priorities of various stakeholders, and these definitions reflect different perspectives of the individual and society. What is particularly important when making judgements of quality in education, as there is no 'correct' view of what quality is, is to clarify the criteria on which such judgements are made.

When judging the influence on educational quality of various teaching- and learning methods, it is obvious that what is judged as contributing most to educational quality by teachers may not necessarily be perceived in the same way by the students. As described in the previous section, using animals in education can have potentially harmful effects on students' emotions and attitudes, and many students have also reported about animal experiments as being negative experiences (see chapter 4, section 'Attitudes and Feelings Among Students'). In these cases, we find a clear discrepancy between the values of teachers and students, and probably also a discrepancy in what they consider constitutes quality in education. The fact that the method of animal experimentation can cause negative emotional effects in the student makes this issue a special case which should be dealt with carefully when discussing quality judgements: Regardless of

how carefully chosen, adapted to specific learning objectives, and in other respects pedagogically valuable an animal experiment may be, if the student experiences discomfort with the experiment, or even feels that it goes against her or his ethical values, the pedagogical effects of the exercise probably risk decreasing. Green (1994) describes the character of the teaching and learning process as follows :

> Unlike the manufacturing industry, the producers and customers (lecturers and students) are both part of the production process making the process individual and personal, depending on the characteristics of both the producer and the customer. (Green, 1994 p. 16)

The special characteristics of the animal experimentation issue should justify the definition of educational quality applied in this thesis as 'fitness for purpose' in relation to the needs to the student as a customer – and as the product – of education. The main question here is whether educational institutions provide education and education services that meet students' short-term as well as long-term needs and expectations. (ibid.) Some general quality aspects of animal and alternative models are presented in this section, whereas educators' views on the quality of these methods are exemplified in the next section. The students' perspective will be highlighted in chapter 4. Other questions related to the 'fitness for purpose' definition, such as whether the right number of graduates are produced in certain areas of study and the needs of employers, will be touched upon in the section 'Implications for Education and Professional Development' below. The criteria on which quality judgements are based by various stakeholders are not always obvious, but efforts will be made to clarify these criteria whenever possible throughout the following sections.

Advocates of humane education often list several advantages of alternative methods that animal models can not provide. These characteristics are said to improve or facilitate the learning experience of the student in various ways, and in this manner contribute to increased educational quality. Such advantages include:

- It is inevitable that some experiments will be done poorly, a fact which can add to the stress felt by students. (Orlans, 1993) With alternative models it is possible to make mistakes and repeat the experiment without causing additional harm to the animal, and thus avoid the negative learning experience of an 'unsuccessful experiment'. (After an unsuccessful animal experiment the student often has to use the results obtained by another student, instead of repeating the experiment with a new animal.) (NSMPD, 1997)
- Alternatives can be easily distributed (Nab, 1989), and repetitions can be made regardless of place and time. (ECVAM, 1999)
- Alternatives can be adjusted to the different learning capabilities of individual

students, allowing them to progress at their own pace, and at their desired level of difficulty. (HSUS, 1993)

- Computer simulation programs can be highly interactive, which ensures a high degree of student activity. (NSMPD, 1997)
- Many factors and variables can be studied simultaneously, and it is possible to get an overall view of many organs and of the entire system. (ibid.) The immediate linking of gross with fine anatomy (e.g. histology) can also be studied. (Balcombe, 1997a)
- Computer simulation programs can eliminate both the detailed work of conducting an experiment and the effects of extraneous variables, helping students to concentrate on a lesson's main point. Physical mechanisms and mathematical variables that underlie biological events are emphasised. Student attention is shifted from techniques to concepts, supporting lecture and textbook material. (OTA, 1988) Some alternatives allow for adaptation by teachers for meeting specific teaching objectives. (EuroNICHE, 1997) Structures can be manipulated. For example, skin can be made transparent so that a critical vessel or nerve is seen lying deep down. Small structures can be magnified to be studied in greater detail. (Kraus, 1994)
- Simulations yield immediate results. (OTA, 1988) The time factor can be manipulated so that long-lasting processes can be compressed to a few minutes, and fast processes can be slowed down. (Nab, 1989)
- Insight can be gained into the relationship between cause and effect and in feedback regulation. (ibid.)
- An alternative model can have built-in self-assessment to allow students to gauge whether stated learning objectives have been achieved. (ECVAM, 1999) Unlike an animal model, the computer can give feedback and hints. (Nab, 1989)
- Alternatives which make use of modern audio-visual techniques offer the possibility of demonstrating phenomena that are normally unobservable in the equivalent animal experiment, such as animations of organ and cell functions (ECVAM, 1999), and 'fly-throughs' of skeletal and circulatory systems which allow the student to tour these systems in three-dimensional space. (Balcombe, 2000a)
- Sufficient data can be obtained from simulated experiments for the students to obtain experience in statistical analysis that is often not possible with animal experiments. (Lluka and Oelrichs, 1999)
- Students have the opportunity to explore experimental design to an extent that would not be possible, or in some cases ethical, with animal experiments. (ibid.)
- Simulations can be made of human experiments as well. For students in fields such as medicine, nursing, and nutrition, computer models thereby provide direct information on human function, rather than information from an animal which in turn is a model for humans. (Smith et al., 1997)
- Virtual reality technology provides very advanced possibilities for the training of medical and veterinary students, for example. A surgeon can create a virtual situation identical to that of her/his patient, and thus practise the surgery before

actually performing it. Learning can also be made easier by the ability of the user to manipulate the image. For example, a virtual dog's abdominal cavity may be enlarged, so that students can walk around inside it. (Thanki, 1998)

- International standardisation of learning methods can be facilitated if there is international co-operation between institutions when developing interactive learning tools. In addition, by exchanging knowledge and programs costs will be reduced and double work avoided. (ibid.)

On the other hand, alternative methods also have their limitations, several of which are pointed out in the following in vivo-model arguments:

- A mathematical model is never complete. Most biological systems are so complicated, that they can never be exactly represented in a model. The more complex the model, the more unrealistic it will be. (ibid.)
- There is a concern that students risk losing touch with reality if they become too focused on alternative models. (Lluka and Oelrichs, 1999) Medical students may unintentionally be trained to ignore the behaviour and appearance of patients and to place unwarranted importance on data from instruments. (OTA, 1988) Also, there seems to be a greater tendency to believe the results of a computer model, whereas unexpected findings in an animal experiment are often investigated to eliminate causes such as equipment failure or poor technique. (Smith et al., 1997)
- Experiments in the 'real world' do give ambiguous data and do fail, and students may need to experience this. (Hughes, 1998b)
- Alternatives may be less motivating for some students. (ibid.)
- The student lacks contact with the living animal. (Nab, 1989)

To summarise the points above, there seems to be a great potential in humane teaching- and learning methods. But whatever the choice of learning method, it will probably not be suitable for all students, at least not to the same extent. Individual preferences will vary. The student's way of approaching various learning tools, and her or his perception of the laboratory exercise as being placed in a meaningful context, are two important factors in the learning process (and also for the student's future role as a professional or a researcher). (Höög, Cronholm and Mårtenson, 1997) The importance of focusing on a flexible, inquiry-based, student-centred approach in education has been emphasised by supporters of humane methods, and there are defenders of the traditional animal model approach who also recognise the need for improvement in this respect. (McInerney, 1993) In a study carried out by Welsford et al. (1995), life-science students enrolled in a core organismal biology course undertook a laboratory exercise designed in two different manners; 1) following a standard demonstrational model where students are told to undertake animal experimentation solely as a

prescribed learning tool, and 2) following an investigative, student-centred model where the animal experiment was a part of an ongoing investigation, the content of which was driven by student-generated hypotheses. The conclusion of the study is that an altered pedagogical approach to animal experimentation may have an impact on student attitudes concerning animal use, which Welsford et al. suggest could justify continued animal usage in the curriculum. The study was carried out in order to meet the growing concern over the use of animal experimentation in teaching, and to find a way to convert the negative attitudes among students regarding the use of animals in research. (Learning outcomes were not assessed.)

That the quality of education, in general, is improved by the use of alternatives has been concluded by a 1995 symposium initiated by the Netherlands Centre of alternatives to Animal Use. (van der Valk, 1997) Hagelin, Carlsson and Hau (2000) present a contradictory example when they refer to two studies, carried out in 1989 and 1999, reporting that pig training laboratories help physicians to perform the procedures on humans and that an emergency medical techniques programme using pigs was a valuable tool for improving physician-in-training ability and confidence.

It should be noted that the quality of any pedagogical approach in laboratory practical classes is (like its effectiveness in fulfilling educational objectives) probably dependent on several factors, such as the set-up of the learning situation, for instance whether elements of experimental design are built into the tasks set for students, and the standard of tutorial advice. Even if alternative methods to a great deal encourage independent and exploratory work, they do not replace good teaching and good tutors. It is also important to ensure that the students relate to the exercise as a practical experiment and not as an ordinary computer exercise. This could potentially be difficult to achieve, if more and more recently graduated tutors have never carried out the hands-on experiment that is being simulated. (Lluka and Oelrichs, 1999)

The degree of seriousness of this problem will probably vary between student groups, and how it can best be dealt with could be the focus of future pedagogical studies and discussions. Hughes (1998a) stresses that computer software must be fully integrated into a course module and clearly associated with appropriate teaching and learning objectives if real benefits are to be obtained. To simply make the material available to the students is insufficient. Students need to be taught how to learn from computer-based learning materials and how to integrate this learning tool with the rest of their learning strategies, and teachers need to be supported not only with information about the availability of software but also

about how it can be integrated into modules.

Another problem is that the quality of education should be judged on the basis of both short-term and long-term learning gains. In evaluations comparing alternatives with animal models, only short-term learning outcomes have been measured (ECVAM, 1999), although Balcombe (2000a) reports on a study comparing surgical abilities of graduates from the Tufts University veterinary class of 1990, in which one third of the students had been using alternatives. The students were rated for surgical competence by their employers at the time of their hiring and again 12 months later. No significant differences were found on either occasion for any of the measures, which included ability to perform common surgical, medical, and diagnostic procedures; attitudes toward performing orthopaedic or soft tissue surgery; confidence in performing procedures; or ability to perform procedures without assistance. More studies should attempt to find out whether the students are able to apply their knowledge, understanding and skills gained by different methods in their profession after graduation. Such studies could also give an idea of how university education best can contribute to producing better pharmacists, better physicians, or better scientists.

Finally, the importance of the 'hands-on' experience with real animals for educational quality will be dealt with in the next section, as there is little scientific support for this argument, which seems to be based more on opinions of individual teachers. (Pope, 1997)

Attitudes and Situation of Educators

Studies have been carried out to investigate teachers' attitudes to animal experimentation in the classroom. In one study published in the *Journal of Biological Education* in 1994, a survey of 28 teachers in charge of biological sciences in secondary education showed that one in three educators argued against the extensive use of animals in the classroom. (HSUS, 1998a)

Another study, carried out by Tsuzuki et al. (1998) and published in the same journal in 1998, surveyed the attitudes to (and the practice of) animal experiments and bioethics among high school teachers of biology and social studies in Australia, Japan, and New Zealand. The study found that Australian teachers were least positive about using animals in experiments, but New Zealanders and Japanese similarly positive to experiments. About two-thirds of all the samples expressed ethical concerns about animal rights or experiments. More teachers had

such concerns in New Zealand, than in Australia, and fewest in Japan. To the question 'Do you think bioethical education is needed in education?' there was over 85% agreement in all countries. The survey also showed that teachers expressed a need for more teaching materials and resources to discuss the bioethical values, as well as ideas on further ways to teach biology and to use animals in class.

In a teacher survey by the *American School Board Journal* in 1992, 52% of respondents felt that dissection should be mandatory, and 35% felt that it should be an optional activity. 13% supported abolishing dissection altogether. (Balcombe, 2000a)

In a survey carried out at Scottish universities between 1985 and 1988, one of the major findings was general agreement among teachers on the need to cover bioethical issues in a first-year biology course. However, very little teaching in this area was actually going on, due to over-crowded courses, lack of expertise, discomfort with 'discussion-based' teaching rather than imparting facts, and the low priorities given in universities to the development of novel approaches in teaching. (Downie, 1989)

The experience of EuroNICHE (European Network of Individuals and Campaigns for Humane Education) is that the attitudes of educators to alternatives in Eastern Europe often differ from those in the West: Eastern Europeans may see computers and modern technology as attractive symbols of status, whereas the resistance of Western professors to introducing alternatives in education has often been great (especially methods and models they have no command of, such as computer simulations). (NSMPD, 1996)

From the perspective of teachers who defend animal experiments in education, lists of advantages of humane alternatives and evaluation studies showing the learning outcomes of students using alternatives often have a minor value. Instead, other factors are focused on, such as the importance for the student of getting the experience of actually handling a real animal.

When Dawson et al. (1991) discuss an article comparing the educational effectiveness of interactive videodisc instruction with live animal laboratories, they claim that there is no substitute for live animal experiments to accomplish the objective of students gaining a deeper understanding of living organisms as '... The tactile sensation of the fibrillating heart or the excitement elicited by returning the fibrillating heart to sinus rhythm by the use of the defibrillator are learning experiences not duplicated by simulations'. (Dawson et al., 1991 p. 34) The authors then go on to deal with the issue of 'unsuccessful experiments', or unexpected results of the experiment, in the animal laboratory, and explain why

they view these as essential parts of the learning experience:

> ... The live animal laboratory experience is commonly enriched by unexpected or unusual observations. The experiences of turning a stopcock the wrong way or of seeing the blood spurt from a cut artery have a value that is not revealed by performance on multiple-choice/ short-answer tests. Experiencing the level of concentration required to prevent such mishaps is equally important and intensifies the learning experiences. Exposure to the conceptual material within the highly stimulating environment of the animal laboratory results in a level of understanding that is different from that taught by the other valuable but fundamentally different teaching methods. (ibid., pp. 34–35)

Dawson et al. conclude with saying that the animal laboratory cannot be replaced even if the alternative method yields better results, as the animal laboratory and the simulation laboratory are different experiences, and that objections to the use of animals in teaching and research are commonly based on misinformation.

Lord (1990) reports on a survey of animal dissection laboratories, where most of the life-science instructors polled felt that the hands-on exploration of a specimen was not only an important phase of learning biology but was also absolutely necessary for its understanding. He stresses that '... Experimentation allows a student to be truly involved in his or her learning'. (Lord, 1990 p. 330) Lord claims that he has never seen reliable evidence that supports the contention that computer graphics can provide the same level of conceptual learning as the experimental laboratory. He refers to other research to support his arguments, saying that the cognitive aptitude of visual-spatial perception (defined as the ability to juxtapose, manipulate, and rotate an object mentally and to create structures in the mind from written or verbal directions) is absolutely necessary for successful conceptualisation in the biological sciences. This cognitive aptitude is said to be developed in the student by exploratory involvement. Lord refers here to activities commonly produced in animal dissection labs such as handling, rotating, manipulating, and envisioning objects, and remarks that 'text, workbook, and computer-based activities rarely stimulate visual-spatial thinking in the student'. (ibid., p. 331) He concludes with a statement about quality of education, based on a concern about the increasing global competition in research that will result in biology students sliding farther behind their colleagues in other countries, if dissection is removed from the life-science curriculum.

The quality aspect of the 'hands-on' experience is stressed also by Offner (1993), who explains why she thinks that this particular experience gives more profound learning than other methods:

> The learning that occurs in a dissection is qualitatively different from the learning that

> occurs in a lecture or paper-and-pencil setting. ... When students know a specimen is real, their attention is heightened, and the information they learn is somehow registered as 'real'. It is a more profound and permanent kind of learning that cannot be obtained in any other way. (Offner, 1993 pp. 147–148)

Offner dismisses the efforts by supporters of humane education to show that alternatives can fulfil a number of learning objectives, by remarking that full understanding can only take place when handling a real animal. In addition, Offner dismisses the viewpoint that dissection is not necessary for the vast number of students who are not planning careers in science, saying that one of the purposes of science education is to ensure a high level of scientific literacy in the general population. In her opinion, dissection is a vital part of this education. Offner bases her arguments on her own experience as a high school biology teacher. (ibid.)

Another educator adds to the hands-on arguments by stressing that the dissection experience can be made inquiry-based and interesting for students, providing it is properly carried out:

> Does the cross-sectional diameter of the two primary bronchi add up to more than the diameter of the trachea? Does removal of a cat's tail change its center of gravity? ... Dissection provides the platform for thoughtful observations, and is not just a vehicle for naming the structure pierced by pin No. 16. Dissection, properly done, provides the opportunity for students to practice and develop the observational skills that all good scientists should have. (Quoted in Lewis, 1997 p. 14)

The criteria used to justify the 'hands-on' argument are in a few cases linked to scientific studies, but more often they seem to be based on a view that the sensory experience a real animal can provide is irreplaceable.

Another argument is that students' self-confidence and stress-handling capabilities may increase when experimenting on live animals. There is also a concern about a future decrease in the quality of research if animal experiments are omitted from the curricula. Variance in research results and an increasing risk of future malpractice which in turn may lead to compromised animal welfare, are possible negative consequences. Future scientists with a lack of sufficient skills to develop new medicines is another. (Hagelin, Carlsson and Hau, 2000) The concern about the proper training of future scientists is shown by an article in *Teacher Magazine*, 1991, in which animal dissection is defended by pointing out that 54 of 76 Nobel Prizes in medicine and physiology in the last century were based on animal research. (Balcombe, 2000a)

A questionnaire on dissection at the undergraduate level, sent out to 218 universities in the United States, generated a number of comments from university representatives. Some arguments are based on an assumption that students

enjoy performing dissections, as very few actually object; others refer to the high costs of introducing alternatives. Furthermore, the necessity of the 'hands-on' experience is motivated by one educator by stating that the ability to dissect an animal, and the ability to make careful observations and distinguish the normal from the abnormal, are necessary skills in many biological and medical fields. (Hepner, 1994)

The importance of a student being prepared for the inherent variability of biology is stressed by Wheeler (1999), who assumes that this feature is lacking in alternative models. Another argument for animal experiments in education that Wheeler puts forward is the importance of students having an understanding of how knowledge in science (research) has been obtained.

The risk of desensitisation of students who are carrying out animal experiments, a concern frequently raised by humane education supporters, is disputed by some teachers:

> Students who have been through a good biology course, who have studied both animals and their relationship with the world in a broad sense, will leave the course with an enduring respect and reverence for life. Dissection is an essential part of such an education. (Offner, 1993 p. 148)

> The use of dead and preserved material per se does not desensitize students or make them less caring and humane, indeed for some an appreciation of the delicacy and intricacy of tissues can enhance respect for living things. (Lock, 1993 p. 113)

Orlans (1988b) quotes the founder of the Association for Biology Laboratory Education, who has expressed that for the majority of students taking part in dissection exercises, the emotional evolution is to go 'from fear, to caring, to killing, to wonder'. Offner (1993) also points to the positive effects of animal experimentation and establishes links between alternatives and threatening anti-science scenarios in the following statement, which reflects a fear of having to give up current teaching methods:

> I am distressed with the amount of time and energy spent looking for 'alternatives to dissection'. The alternative to dissection is ignorance, and let us never forget that ignorance comes at a terrible price. There was a time in history when dissection was forbidden, when even medical students and doctors could not see the insides of animals. We call those times the Dark Ages. They were not a time of respect for life. They were a time of ignorance, and along with the ignorance came tremendous insensitivity and cruelty. In the absence of real medical knowledge and understanding, superstition prevailed and all kinds of grotesque mutilations were performed in the name of science. One of the most important lessons to come out of the Dark Ages is that love and respect for life come from knowledge and understanding and not from ignorance and its invariable handmaidens, fear and superstition. If this sounds farfetched, imagine what

> this country [the United States] would be like if nobody had dissected in the last 40 years. (Offner, 1993 p. 148)
>
> We should not be deluded into thinking that alternatives to dissection are the 'wave of the future'. They are not. They are a step back into a grim and ignorant past. (ibid., p. 149)

Now the focus of this study will turn to educators with a positive attitude to alternative methods in education, and the arguments they put forward. Russell (1999), who represents a category of educators with strong ethical awareness, takes the desensitisation concern seriously:

> Even if the teachers had the best possible training, and even if the experiments were always successful and were always carried in the most humane way possible, the destructive effect of the experience on the student, in my view, simply would not be worth it. My opposition to vivisection in the classroom is based on a concern for the humane treatment of animals and, equally, a concern for the emotional and mental life of the students. (Russell, 1999 p. 3)

Russell further points to the advantages of alternatives, such as flexibility. He regrets that the ethical dimension of animal studies is often missing in the learning situation, and suggests that alternatives have an important role to play in pedagogy as they provide '... a framework for the development of a new ethos involving animal use not only in a learning environment but also in biomedical research in society'. (ibid., p. 1) A similar view on ethics in a wider context is expressed in the following statement:

> The question of dissection is not, '...is it educational?'; but, '...is it educational in terms of the new world view?' Examined in this light, the answer is obviously not! To sacrifice entire populations of animals is to model the old paradigm for our students that Man is the paramount organism in the scheme of life and that Man can act with impunity towards the rest of nature. Any 'educational benefit' would have to be justified against that model. In the new paradigm that we must be about teaching, there is no justification with sufficient weight to validate such a practice. (Quoted in Hepner, 1994 p. 195)

Other perceived benefits of alternatives are that students seem to feel more comfortable using them, which contributes to an effective learning situation when students do not have to worry that they might do something wrong, and also the close similarity of results obtained from alternatives compared to the results obtained from the equivalent experiment using the animal model. (EuroNICHE, 1999)

The possibility of integration with other disciplines is another advantage with alternative methods, explained in the following way by one educator:

> It allows for unlimited repetition, and it also allows you to make direct comparisons

> between different animals, to compare the histology between different groups. As it is now, the histology course is usually separated from the morphology course, which means that first you study the histology and you might not even know what kind of organ you are looking at, and then a couple of months later you see the actual organ. Here you see it all at the same time, which I see as a big advantage. (ibid.)

The motivating effect that alternatives have on students is another benefit stressed by teachers:

> The POP-Trainer is a really simple and easy to use device for simulating operations. The simulation is perfect, and you can train especially well the management of bleeding. You can train as long as you want, and no animal will die. ... It is very nice for us to see that the trainees don't want to stop training even when the time is over. (ibid.)

Another educator has found that the descriptive nature of dissection does not quite fit a pedagogical philosophy or curriculum that stresses application of the scientific method. He has replaced dissection in the introductory lab course with a programme in which students design and carry out experiments using a rapidly growing plant, as he had grown frustrated trying to get students to approach dissection as an inquiry-based investigation:

> I tried several ways to convince students that dissection was a very useful tool in biology. I asked them to replace organs back into the pig using incorrect spatial orientations and then ask such questions as, 'Okay, you have used the sequence mouth-small intestine-stomach – why would this be a problem in a live pig?' It didn't work. I still could not elevate, in the students' minds, dissection above something regarded as an easy and 'fun time' in lab. (Quoted in Lewis, 1997 p. 13)

Davies (1999) remarks that the length of time dissection takes up in already very compressed veterinary education curricula makes it too expensive and inefficient to be the predominant means of learning about living animals. Another educator motivates why the time-saving aspect is important:

> One of the advantages is that you can do things in a shorter time, and because of this you can do more, you can concentrate more on the real teaching objectives. In the past students got confused by the equipment, by the set-up. We can do it easily now with computer simulations. ... You can do things with this program that you can't do with the real animal. (Quoted in EuroNICHE, 1999)

Bjellin (1990) bases his reasons for using alternatives on the future development of the industry as employers of tomorrow's graduates:

> At the Department of Zoophysiology in Lund, we have for several years been working on changing the range of laboratory exercises in a direction toward a decreased use of experimental animals. Ethical reasons have not been the most crucial; rather there has

> been an ambition to renew the range of exercises and better adjust the procedures taught to what is being used within the industry that is the most natural employer of zoophysiologists – the pharmaceutical industry. During the last ten years a very large part of the development and test methodology there has been transferred to in vitro, usually cell models. We must therefore, in education of tomorrow's pharmacologists/toxicologists, concentrate more on those procedures that in other contexts are called 'alternative methods'. (Bjellin, 1990 p. 6, author's translation)

Bjellin is certain that the pharmaceutical industry has a great interest in alternative methods, as his department has close contacts with this industry. (Bjellin, 1986) He also explains why he considers animal experiments in education unnecessary:

> In educational contexts we simply do not need to carry out animal experiments and can apparently still fulfil our tasks as educators. The same education sometimes has, and sometimes has not, animal experiments, in different parts of the country. In many places, some laboratory exercises with experimental animals have for various reasons been omitted, without having caused that the quality of that education has been questioned. In other words, it is possible to say that the alternative is *not* to carry out a previous experiment. (ibid., p. 6, author's translation)

Bjellin develops his position further by saying that if he could find any disadvantage with the alternative, he would not replace the animal experiment. (EuroNICHE, 1999) This statement makes it quite clear that educational quality is his primary concern. Other reasons mentioned by educators why animal experiments in education can be considered unnecessary, are that there are many other ways of demonstrating physiological principles, and that the purpose of education is not to find new knowledge but to teach things that are already known. (ibid.)

As long ago as 1943, a medical doctor focused in the *Medical World* on another argument against animal experiments in education; namely the dissimilarities between animals and humans:

> In a recent leading article in one of our contemporaries it is very properly stated that 'there is a risk in drawing parallels between dogs and man'. That has all along been my contention. Physiologists and pharmacologists, however, are teaching their students the effects of drugs on animals and the almost invariably contradictory results of experiments performed on the latter under anything but normal conditions. Rats, mice, rabbits, dogs, cats and in fact all animals practically never react in precisely the same way as humans, even if such experiments were to be conducted on animals in their normal state. To me such teaching is a sheer waste of time. (Quoted in Animal Aid, 1991 p. 9)

Finally, two examples will be given of standpoints that can be located somewhere in between the two completely polarised attitudes illustrated in this chapter. Hagelin, Carlsson and Hau (2000) take a typical 'reduction' stance (speaking in

terms of the Three Rs concept), and so does an anonymous university representative, quoted in Hepner (1994), in replying to a questionnaire:

> Many of the alternatives described might be useful as introductory complements rather than substitutes to the use of live animals. The ongoing technical improvements of these alternative techniques may make them more useful in the future. For the time being, alternative techniques to the use of live animals may be useful particularly at initial stages of training, but the use of live animals is necessary in more advanced courses. (Hagelin, Carlsson and Hau, 2000 p. 39)

> We have tried, and continue to try to find alternatives, where appropriate, to animal use. However, there are some cases where the use of animals is deemed necessary as no equivalent substitute is available. I assure you we try to use the minimum number of animals. Given that this is an institution of higher learning, any use of animals is deemed necessary to illustrate the principles of a lab exercise. The laboratory is an integral and invaluable portion of the educational experience for it is only in the lab that many structures and concepts become real to a student. (Quoted in Hepner, 1994 p. 60)

Teachers may face pressure to maintain animal laboratories. A biology lecturer at Illinois Wesleyan University believes his contract was not renewed because he included discussion of the ethics of animal use in his lectures to his students. In many cases, biology teachers are not merely encouraged but expected to use animal dissection in their classrooms, regardless of the teacher's personal preference for teaching method. (Balcombe, 2000a)

Regardless of what ethics may dictate, budget constraints are often given as the reason that animal models are not replaced by alternatives. (Balcombe, 1997a) According to Smith et al. (1997), many centres of learning are moving towards alternatives to animal experiments for ethical reasons *and* for reasons of economy such as the high costs of laboratory equipment, dedicated laboratory space, and recurrent expenditure on consumables (such as animals, reagents, and disposable apparatus). In a comparison of a computer simulation program and a traditional laboratory practical class for teaching the principles of intestinal absorption, the laboratory session was found to be almost five times more expensive. (Dewhurst et al., 1994) When it comes to animal specimens used for dissection, the HSUS has made a cost analysis showing that for a typical school's needs, the cost of providing animal specimens was often greater than the cost of purchasing a range of reusable alternative materials. Even if the initial cost of investing in computer programs, three-dimensional models and other alternatives may be higher, there can be a long-term economic benefit with using alternatives as they can be used repeatedly, while the animal specimens must be replaced after a single use. (Balcombe, 2000a)

Nevertheless, the cost is a problem in many countries. In Russia, for example,

there is a lack of equipment to demonstrate alternatives, and if an institution of higher education does have the necessary equipment, often foreign software does not fit the domestic computer systems. The economic situation also means that the number of animals used decreases as well, as the educational institutions have difficulties in affording them. (Maroueva, 1997)

In the long run, the most serious problem with introducing alternatives may be the lack of professional academic rewards for faculty members working in this area. Promotion, tenure, and salary increments are awarded predominantly for productivity in the research laboratory, not for efforts to develop innovative teaching techniques and materials. This is a particular problem for junior faculty members, who must often devote their major efforts to climbing the academic ladder. (OTA, 1988)

Implications for Educational and Professional Development

Animal experiments, especially dissection, have been criticised for being a quite old-fashioned way to carry out science education. Downie and Meadows (1995) say that dissection can be criticised for dating from the days when comparative anatomy was a major part of biological *research* as well as teaching. This view is illustrated by the organisation Psychologists for the Ethical Treatment of Animals (1995), saying that 'hands-on' does not mean what it once did:

> If hands-on refers to a learning experience that best approximates the applicable working experience, the teaching lab should no longer consist of the dissection of frogs or cats. To produce the physicians and research biologists of the next generation, we would be well-advised to leave the frogs in the ponds (while there are still some left) and refurbish the teaching lab with cd-roms. (PSYeta, 1995 p. 1)

Juliana von Wendt's Fund For Science Without Animal Experiments in Finland (1997) also criticises university teaching methods for not following the advancement of biomedical sciences and research methods: Laboratory animal practicals are obligatory in the training of scientists in Finland, whereas cell culture techniques are taught on an irregular basis, mostly in post-graduate training, and the courses are optional for the students. In this way, students do not get a holistic view of biomedical research methods and the scope of their use.

There is also a quite opposite view on this issue. McInerney (1993) refers to an article in the *Washington Post* in 1991, in which dissection was claimed to be unnecessary because there has been a shift in the focus of biology from anatomy

and structure toward the nature of the cell. McInerney calls this position 'bad biology', and remarks that cellular organelles, nucleic acids and antibodies ultimately exert their effects in whole organisms. The Swedish Ministry of Education is concerned that there will be negative consequences for research if many students abstain from animal experiments (at least in the laboratory assistant programme). (Utbildningsdepartementet, 1994)

Future employers of those students who undergo education where animal experiments and/or work with alternative methods are included are important 'stakeholders' when judging the benefits and drawbacks of the different methods, as they will experience how knowledge and skills achieved during the education will be applied to a concrete work situation in a professional context. Due to an apparent lack of evaluation studies measuring the long-term learning gains of these categories of students, it seems risky to make any statements about the professional development concerning the two groups. In addition, there will probably be considerable individual differences among students depending on other factors unrelated to the experimental model used in laboratory classes several years earlier.

As seen in the section 'Attitudes and Situation of Educators' above, judgements of which model is preferable from this perspective often come from educators (who themselves are often involved in the formation of curricula and course content, and therefore probably biased), rather than from employers. There is a risk of distance from reality involved here, if we assume that not all educators have regular and close contacts with the industry and other parts of the job market that will employ their students. Their opinions, much like opinions on animal experiments in education in general, seem to fall into two major categories: There are those who are concerned that replacement of animal models will result in insufficient skill and experience, and a lack of various other kinds of capabilities necessary to be able to reach an acceptable level of performance in the profession, which in turn may lead to a scientific decline. Others believe that students who question prevalent scientific norms and have been exposed to alternative models during education might even become better scientists and professionals, more compassionate toward laboratory animals and animal and human patients, and possessing the potential to influence and renew scientific development in a more creative and humane direction, instead of uncritically reproducing old patterns.

The situation is probably different for students who take part in education where alternative methods are fully integrated into the curriculum, and for conscientiously objecting students who have chosen not to follow the ordinary

curriculum. After graduation, the latter category risks having to face prejudice and suspicion from employers, questioning that the applicant has properly fulfilled the objectives of the curriculum. As the Swedish Ministry of Education puts it;

> To refuse participation in these [animal experiments in veterinary education] would lead to unacceptable knowledge gaps. If occasional students choose to go through veterinary education without participating in animal experiments, the chances are therefore very small that they would ever be employed as veterinarians. (ibid., p. 154, author's translation)

The reaction will probably depend much on whether the information that the student has opted out from animal experiments is given in the diploma. For some professions, this information is clearly more relevant than for others. (ibid.)

One conscientious objector, a zoology student from University College of Wales at Aberystwyth, decided to follow up on the fact that she had been told by her lecturer that she could not expect to be employed if she had no experience of dissection. She wrote to between 30 and 40 organisations, asking whether they would consider employing a university graduate who had not dissected. Each organisation replied that, although they did not want to encourage her to go against the wishes of the university, they would definitely consider employing such a student. (Jukes, 1997b)

Another zoology student at King's College, London University, has a similar report. Despite a prediction from one of her tutors that without 'hands-on' (dissection) experience of animals, her degree would be next to useless and that all she would be fit for would be a check-out job in Woolworths, this student has put her zoology degree to use in several ways since her graduation. (Johnson, 1991) Balcombe (2000a) refers to a study carried out in 1992, which showed that of three graduating veterinary students who had taken the alternative track in the Washington State University veterinary programme, all received job offers, and two of them were hired because of (not in spite of) their participation in the alternatives program. (However, this case must be considered different from the two previously mentioned, as alternatives had been accepted by the university as an eligible option for the students.)

A different view on the situation has also been put forward, namely that the pharmaceutical industry has expressed concern about the lack of hands-on experience with animal procedures in some university courses. (Hagelin, Carlsson and Hau, 2000) This statement also contradicts the view of Bjellin, quoted in the previous chapter. There might certainly be great differences of attitudes between employers in various fields, as well as individual differences.

Another perspective on the development of the scientific profession is that some students might be turned off from a career in the life sciences due to obligatory animal experiments in their education. Many have been forced to change course or drop out. There are examples of educators explicitly stating that students who have a problem with animal experiments should not be in the life sciences. (Hepner, 1994) Being aware of what will be required of them, some students might choose not even to consider this field as a career choice (Jukes, 2000), although they later may well be able to choose directions in their future profession that do not involve animal experiments. The operator of a U.S. Dissection Hotline estimates that since 1989 she has spoken with over 100 callers who have either changed career goals or avoided biology studies, entirely because of dissection assignments. (Balcombe, 2000a) As a result, bright students who are well suited for a professional career or research in the life sciences may choose careers in other fields. (HSUS, 1998b) Those who are dissuaded may well be the more compassionate students, whereas students who are less sensitive may remain in the field (although this is not necessarily the case). (Balcombe, 2000a)

This effect that animal experimentation may have on students is confirmed by the study by Solot and Arluke referred to in the section 'The Hidden Curriculum' above, which concluded that dissection exercises may dissuade students, especially girls, from pursuing careers in scientific fields. (Solot and Arluke, 1997)

Quite the opposite view is held by Offner (1993), who is concerned that laws that restrict dissection would be a factor in discouraging women from going into science, as it would be 'cool' for girls to not want to dissect. According to Offner, this is a reason for opposing such laws, as it would be a disservice to these young women to give them what in Offner's view is an easy way out. Offner is convinced that animal experiments nurture an interest in science in almost all students, once they are exposed to them.

Yet another, slightly different view on the same issue, is held by Hughes (1999) and a respondent to a questionnaire in the United States (Hepner, 1994). They remark that the full realisation of what is involved in working with animals is only appreciated during hands-on exercises or when an animal has to be killed, and that this appreciation is vital before students embark on Ph.D studies or take up appointments in industry if they are not to risk making a disastrous career choice.

CHAPTER 4

Student Aspects

In the same manner as the previous chapter focuses on educational aspects of teaching- and learning methods and educators' attitudes to them, this chapter deals with the issue from the perspective of students. Of relevance here are not only students' attitudes and arguments, but also the way they experience the learning situation, their possibilities and formal rights to influence it, and how they are met by the educational establishment.

Conceptual Framework: The Relationship Between the System and the Individual. Burrell and Morgan's Interpretations of the Nature of Society

How students are met by the educational establishment when objecting to animal experiments in a laboratory class can be seen as a matter primarily between the individual student and the individual teacher. This section, however, will attempt to place the issue in a broader sociological context by applying theories presented by Burrell and Morgan (1993). This will be done by linking the specific situation of conflict that arises when a student opposes her/his university's requirement to carry out an animal experiment, with Burrell and Morgan's ideas of the general structure of the societal system as a whole as including elements of social control and resistance to radical change.

Burrell and Morgan refer to the work of Dahrendorf and others, in which two models of society are developed; one model of *order*, where social systems are characterised by commitment, cohesion, solidarity, consensus, reciprocity, co-operation, integration, stability and persistence, and one model of *conflict*, characterised by coercion, division, hostility, dissension, conflict, malintegration and change. These two models of society can be interpreted in different ways; as two sides of the same coin, not mutually exclusive, or as essentially separate perspectives without a common base. Burrell and Morgan argue for the latter analysis, saying that extreme forms of conflict cannot have integrating mechanisms, but

imply radical transformations of society not consistent with integration/social order.

One strand of the order-conflict distinction is the distinction between *consensus* and *coercion*, which focuses upon values. Burrell and Morgan present the possibility that shared values (consensus) may be the product of the use of some form of coercive force, that is, may be imposed on some members of society by others. From this perspective, 'consensus' may reflect a legitimised power structure, successfully exercising forces of domination, rather than integration. The consensus/coercion perspective can also be seen as focusing upon the issue of social control, in that coercion may arise through the control of value systems.

That the educational establishment conveys societal beliefs, values, attitudes and moral codes that are embedded in curricula, and that the teacher-student relation may involve a degree of domination in the laboratory class situation, has been dealt with in chapter 3, section 'The Hidden Curriculum'. Here, the legitimised power structure is represented by the teacher/institution, imposing values that are accepted by society on the student who may oppose them, but who will in that case miss out on integration and perhaps also acceptance. Most students, however, will adjust to the situation, and whether the consensus that arises is acquired autonomously by the students, or imposed upon them, can be an issue to be discussed. Balcombe (1997b) has observed that in the typical setting for dissection exercises, there appears to be little to encourage, and plenty to discourage students from openly objecting to these exercises: In a majority of courses, dissection is presented not as an option but as a required part of the course, and if an option to use alternatives exists, the student is often not informed about the choice but must request it. In such a situation, the student faces a number of risks in opposing the norms of the institution. These include the possibility of losing grades, ridicule and humiliation in front of one's peers, lost time (e.g. as a result of dropping the course), and feeling compelled to change one's career choice. This makes the student feel under great social pressure, especially at a time when it is important for her/him to try to gain acceptance by authority figures and peers. (Hepner, 1994) As a result, few students go public with their objections to animal dissection, but do the required dissection without open complaint, even if it goes against their ethical convictions. (Balcombe, 1997b) There are other views, as illustrated in chapter 3 ('Attitudes and Situation of Educators'), stating that most students, if properly introduced to the exercise, will feel convinced about the benefits of the activity and (more or less) voluntarily absorb the values involved.

Burrell and Morgan also suggest that the problematic (and, in their view, often

misinterpreted) order-conflict view of the nature of society should be replaced by the equally polarised notions of *regulation*, concerned with the question of why society is maintained as an entity, and *radical change*, focusing on finding explanations for phenomena like structural contradiction, modes of domination, man's emancipation from limiting structures, and alternatives to the acceptance of the *status quo*. Included in the regulation model are, for instance, elements of social order, integration and cohesion. It presumes that it is possible to identify and satisfy human needs within the context of existing social systems, whereas the radical change model notes that the social system prevents human fulfilment and that material and psychic deprivation of man is a result of the *status quo*. In the light of this and the previous analysis, the dissection/vivisection conflict can be interpreted as a conflict between the student's wish to achieve a change that shows respect for her/his ethical values, and the educational institution's wish to maintain a *status quo,* for fear of causing an unwanted domino effect among the students if the option of using an alternative were to be made clearer. This could in turn bring about a structural change that might undermine important elements of the current order such as existing patterns of authority, control, and academic freedom. Offner (1993) exemplifies with a statement concerning legislation that requires teachers to excuse a student from dissection:

> One bill proposed, and fortunately defeated, in Massachusetts in 1991 and 1992 says that teachers must notify students that they 'have the option of being excused from this activity and that no penalty shall result from the student's decision to not perform said dissection'. Think about the effect of such a statement in a classroom. You are telling teenagers that the class will be dissecting, but if they don't want to dissect, they don't have to. This particular bill is remarkable for the lack of requirement it puts on the student. ... Any student can simply say, for any reason or for no reason, that he or she doesn't feel like dissecting, and the teacher must comply with the request. You can imagine how disruptive this would be. ... The long-term effect of such bills would be to make dissection so difficult and disruptive that people would slowly stop doing it. (Offner, 1993 p. 149)

Another reason for wanting to maintain the *status quo* may be a reluctance to examine in class the deeper moral and ethical questions that arise from the conflict (Lewis, 1998), due to various factors such as those mentioned by Downie (p. 48 above), or due to a reluctance on the part of educators to acknowledge that some part of the curriculum that they themselves are implementing might be morally wrong. (Orlans, 1988b)

Jukes (1997a) has a more positive view on the role conscientious objection is playing in the educational context, and the changes that may be brought about.

He states that students who object to animal experimentation have a very important function in the social conscience. They are keeping the discussion about ethics and personal responsibility alive, and ensuring that science does not operate in a moral vacuum. He also remarks that students have a potential to bring in new ideas to disciplines in which change, at least in some areas, has rarely taken place. The most important thing, however, is that students are stakeholders in their education and should have a say, and, above all, that their ethical positions must be respected.

Attitudes and Feelings Among Students

The previous section suggested that not all students who feel concerned about animal experiments in education actually express their concerns openly. Regarding dissection, Balcombe (1997a) estimates that on average, about 3 to 5% of a class population raises unsolicited questions or objections to dissection. Many published surveys confirm that student concern about the use of animals in dissection and other educational settings is far greater than is borne out by student protest in the classroom, but most of these studies have been based on quantitative attitude surveys that suffer from superficiality. Few qualitative studies of the issue exist. (Balcombe, 2000a)

A compilation of 13 studies examining student attitudes to animal use in education at various levels in the United Kingdom, the United States, Canada and Australia, shows that between 27 and 60% of the students surveyed in most of the studies disapproved of performing animal experiments of various kinds. When the survey looked at the students who were positive about a student's right to opt out from such labs and use alternatives, the percentage rouse to about 80% in some studies. (ibid.) At least one of these studies, examining 14/15-year-old students' attitudes, showed that the sampled females tended to be more strongly against animal use than the males: 52% of the females and 22% of the males answered that they would object to any animal material being used for dissection. (Millett and Lock, 1992) Another survey (not included in the compilation) carried out at seven Finnish universities in 1994 also concluded that women were more strongly opposed to animal experiments than men: About 40% of the male students wanted to participate in animal experiments in their education and wanted to start them early on in their study programme, whereas only 15% of the females wanted to do the same. But still, men also (62%) supported the freedom of choice for

students. In total, 64% were not willing to do animal experiments themselves, and 51% thought that alternatives are not used enough. The survey also revealed that 71% of the students considered that participation in animal practicals in education should be voluntary for the students. (Salmi, 1994)

Cervinková (1994) presents the results of several opinion polls conducted among students at three medical departments in the Czech Republic. At two departments, around 40% of the students expressed disagreement with the use of animals in medical education. At the third department, an overwhelming 87% of the students replied that they had no opinion, and among the remaining 13%, exactly half of the students strongly agreed with using animals, while the other half strongly disagreed. In another study, a report by Downie and Meadows (1995) of a dissection opt-out scheme in university level biology states that over a period of five years, around 10% of the students have chosen to opt out of the dissection, and that an overwhelming majority of all the students supported the opt-out scheme.

A survey of students at high school level (grades 9–12) conducted by the Albuquerque Public School system found that 46% of the students said biology classes should perform dissection, 24% said that biology classes should perform dissections only if all students in the class wanted to, and 19% said that dissections should not be performed. 72% of the respondents felt that students should be offered alternatives. (Hepner, 1994)

In a survey carried out in 1986 of the attitudes to animals among British secondary schoolchildren, it was found that 73% of younger students felt 'bad' about carrying out their first dissection, and at the age of 15 this was still the case for 36% of the boys and 58% of the girls. (Langley, 1991) Findings from the Animals and Science Education project in 1992, suggest that while over 50% of a sample of 14 to15-year-old students had either carried out or observed dissection, many felt that they had learned nothing from the activity. (Lock, 1993) In 1989, ninth-grade students in Ohio were polled for their opinions on dissection. It was found that a third of the students were bothered by dissection. 90% agreed that they should be allowed to choose an alternative and half of the students said that, given the choice, they would choose an alternative. Over 80% of the students said that teachers should encourage students to share their feelings about dissection, and that animal rights should be a part of biology class. Some students said that they were not taking biology because of the dissection requirement. (PETA, 1990)

Nancy University in France has experience with an interactive computer simulation program (CAL) in the curricula of physiology and pharmacology.

When the students evaluated the CAL packages, they felt that the use of CAL was superior to reading, a lecture, or a practical, but inferior to a tutorial. They were prepared to recommend the packages to be used again, and felt motivated for further study. The students' overall impression was positive. Some positive remarks were that 'experiments' could be performed without the hassle and fear involved with the use of live animals, there was a real possibility to learn from one's mistakes as experiments were easy to set up, student-staff interaction was better given the reduction in student numbers compared to a lecture situation, and using a CAL package was fun. Some students had negative comments, such as boring experiments without 'feeling', too distant from reality, oversimplification of the true difficulties involved in doing an experiment, and no conveyance of principles of experimental design. (Atkinson, 1998)

In 1997/98, students of medicine and human biology in Marburg, Germany, evaluated the multimedia simulation SimNerve, which was part of a practical physiology course. The majority indicated that they may have learned more using the alternative than if they had done a real experiment, and a great majority viewed SimNerve as an ideal alternative to the real experiment. More than 80% of the students were positive to the alternative compared to other practical training experiments in the same course. The majority found it interesting to work with this program, and they felt that it helped to increase their understanding of nerve physiology. Prior to using SimNerve, the students were positive about the opportunities to replace experiments carried out on organ preparations by multimedia simulations in general, and following the SimNerve experiment, this positive attitude had increased even further. (Braun, 1998)

Not all studies reveal unambiguous opinions among students. A survey of students in a first term biology course at Glasgow University (included in the HSUS' compilation previously mentioned), shows that although rat dissections get high disapproval ratings, they also score high for interest among the students. The students in this survey were also less reluctant to use animals that had been killed for some other purpose (slaughterhouse materials), compared to an animal that had been killed especially for dissection. (Downie, 1989) A survey carried out in 1989 to learn how British veterinary students regard some animal welfare issues found, on the question of animals used in teaching, that most students felt that videos could replace a lot of the invasive use of animals. Although some students did not like doing dissections in school, they felt it had been useful. The attitudes of teachers were mentioned as being important, whether they had been indifferent, or respectful and encouraging ethical dialogue. (Stewart, 1989)

Söderlund (1990) reports that many students in medical, laboratory assistant and biology education find that whether animal practicals are necessary or not depends on the field in which the student will specialise in the future. In a survey among college undergraduates carried out by Lord and Moses (1994), over 80% of the students did not object to the dissection of preserved animals in life-science classes, but experimentation with live animals was not supported by the students.

Furthermore, the more complex the animals are, the more student objections to dissection increased. Dissection of mammals, especially, caused reluctance among the students. In this study also, female students were most likely to resist lab work with animals. The separation between the sexes became more significant with the dissection of more complex animals. Interestingly, senior students responded least favourably to dissection, and 47% of the seniors surveyed thought they could handle the course equally well without dissection, but only 25% of the freshmen believed they could. Similarly, over 40% of the female respondents felt they could learn as much without dissection, but only 29% of the males felt that way. Nevertheless, the study concludes that most students feel animal experimentation is a valuable experience in life-science education. Similar results were found in a study carried out in 1993. In this survey, 64% of biology first-year undergraduates objected to experimentation on live animals, and 17% disapproved of dissection. (Hagelin, Carlsson and Hau, 2000)

The findings of a study of veterinary students in 1997 supports the conclusion that if given a choice, students prefer experimenting on dead rather than live animals. (ibid.) The study by Solot and Arluke in 1997, outlined in detail in chapter 3 (p. 38 ff), reveals that it was important to many students that their dissection specimens were unborn and 'already dead when you got 'em'. The students also expressed concern for the origin of the animals they were dissecting.

That many students find dissection acceptable is reported by some other studies. Lord and Moses (1994) report on a Biological Science Curriculum Studies student survey which found that the dissection of preserved animals ranked as one of the most worthwhile learning activities in life-science classes. Balcombe (2000a) outlines another study that observed, interviewed and gave questionnaires about a foetal pig dissection to 17 high school students enrolled in an elective biology course. Nine of the students wanted to pursue careers in science or a medical field. All students had previous experience of dissection, and alternatives were not offered to them. There was little discussion of the ethics of animal use in the course. 12 of the students (71%) liked the experience; the remaining five (29%) disliked it. 11 students had no moral objection to dissecting a foetal pig, which was

described by the teacher as a by-product of the slaughter of pigs for food. Three students thought that dissection was unethical (including one of the students who liked the experience), and three were undecided. The study also revealed that none of the students reported that they were turned off science careers after the dissection, and there was a lack of insight among the students about broader philosophical issues such as the nature of living things and humans' relationship with animals. Almost none of the students reported that dissection had stimulated their curiosity about such issues. The students had not found previous dissection of frogs, worms, clams and fish especially interesting, but that interest level increased with a mammal (foetal pig), presumably because of the pig's anatomical similarities to humans.

Another study reports on positive attitudes among students to live animal experimentation. Veterinary students were surveyed on four occasions between 1986–87 and 1991–92. The students gave high ratings to the use of live animals for learning surgical principles in the laboratory. The study reports that the use of live animals was rated higher by the students than were alternative techniques. (Hagelin, Carlsson and Hau, 2000)

A professor at Tartu Agricultural University, Estonia, notes that in his experience, most students adopt no active position towards alternatives. A few might object, but no serious conflicts are known. Most invasive animal experiments at the undergraduate level have been replaced, and some students are disappointed at being prevented from performing vivisection. (Reintam, 1997)

In a study comparing CAL and a traditional laboratory practical class for teaching the principles of intestinal absorption to undergraduate students, student attitudes to both learning methods were assessed. The students were divided into a test group, using CAL, and a control group, using the traditional approach. The majority of the test group believed that there was a place for non-animal-based teaching in physiology and that using animal tissue did pose a moral dilemma. Some thought that animal experiments in undergraduate education should cease. The test group also became more convinced after they had used the computer program, that it could be an effective replacement. The majority of the control group, on the other hand, thought that the use of animals was essential in undergraduate physiology teaching, although it did still pose a moral dilemma. Particularly after their laboratory sessions, the control group did not think that CAL could be an effective replacement. Thus, in both cases, the attitudes of the two groups were strengthened after students had completed their respective classes. However, both groups felt strongly that a combination of CAL and animal

work was effective and that CAL did have an important role in undergraduate studies. (Dewhurst et al., 1994)

Söderlund's thesis on animal experiments and conscientious objection at Lund University outlines a number of arguments and attitudes to animal experimentation in education as stated in student questionnaires. Even among students with a basically positive attitude to animals as a learning tool, mixed feelings seem to be common. All quotations below are taken from Söderlund's investigation (1990 pp. 66, 73–77), and have been translated by the author of this study.

Students in the survey who had not exerted conscientious objection, either gave the reason that they did not know about the possibility, or gave any of the following reasons:

> Even if I have ethical doubts, I find the knowledge content more important. (Biology student after laboratory class)
>
> I have not considered the exercises as unnecessary and painful. (Biology student after laboratory class)
>
> Serious research should be included in education. (Medical student before laboratory class)
>
> I am too lazy to voice conscientious objection, very bad, I know. (Medical student after laboratory class)
>
> The frog's life would have been sacrificed even if I had not been there. (Medical student after laboratory class)
>
> I do what has to be done. But I have ethical doubts about this. (Biology student after laboratory class)

The questionnaire also included the question 'Do you believe that it is possible to become a good physician, biologist or laboratory assistant without having carried out animal practicals during education?'

> Some experiments could be filmed. Some probably need to be carried out, or observed. They support memory – but I doubt whether they are 'necessary'. (Medical student after laboratory class)
>
> Yes, I think so, because there are so many other things to do as a physician, laboratory assistant, or biologist. It also shows that you have some feelings, which is needed in the profession. (Laboratory assistant student before laboratory class)
>
> Yes, probably. But you cannot become a good researcher! (Medical student after laboratory class)
>
> No! You cannot take a stand before you have experienced it. You limit your possibilities if you don't do it. (Laboratory assistant student before laboratory class)

It depends on where you will work and with what. It is good to have the experience so that you are not completely unfamiliar with it when you come to a work place. (Laboratory assistant student after laboratory class)

No, it is necessary in order to understand various biological relationships. This cannot be learned theoretically. There must be practical classes. (Medical student before laboratory class)

Yes, but it is a very good way to learn how to anaesthetise, operate, and suture. (Laboratory assistant student after laboratory class)

You should see what it really looks like, like how body organs in an animal are located, and how they look. (Biology student after laboratory class)

It depends completely on future professional activities. Perhaps this module should be offered only to those students to whom they are relevant, and in the final period of education. But my opinion is that teaching of animal experimental methods is helpful for many professions. (Laboratory assistant student after laboratory class)

I am sure about that, but many things become clearer through an experiment on a decapitated frog. (Medical student after laboratory class)

Perhaps, but experiments facilitate understanding of the physiology and anatomy of human beings. (Medical student after laboratory class)

NO! But it depends a little on what kind of specialisation is chosen. Would you like to be operated on by somebody who hasn't tried before? (Biology student before laboratory class)

No. What choice do you have if you want to become a physician? (Medical student before laboratory class)

No, I think surgeons, especially, need the animal practicals in order to become as skilful physicians as possible. (Laboratory assistant student after laboratory class)

Yes and no. To become a physician at all you probably have to work with animal experiments. (Laboratory assistant student after laboratory class)

Various other comments from medical students after laboratory class:

If animal experiments must be included, the student groups can be made larger, so that fewer animals have to sacrifice their lives.

I could wish that it was an alternative to carry out animal experiments, instead of the other way around.

In my case some animal experiments have been well motivated and instructive, while others have been very unnecessary!

Our material has not been live, so even though it is unpleasant to work with it, it feels necessary.

I had some feelings of discomfort the first time I euthanised a laboratory animal.

> The value of the laboratory exercises varies. Some exercises you get something out of while others have no relevance for your education.

Comments from laboratory assistant students after laboratory class:

> The few experiments we have carried out during education have been a rich experience.
>
> It was interesting to see what the animals look like inside. Good to have tried giving injections.
>
> Before carrying out the animal experiments I didn't know what I would think about it. Afterwards I was positive towards it.
>
> Animal experiments are unpleasant but at the same time very interesting.
>
> The fact that I couldn't manage the animal experiment was due to the assistant's nonchalant attitude to the laboratory animal. If he had proceeded in a neater way I would have been able to manage.

More explicitly negative attitudes to animal experiments and the way they are carried out in education are also found among these students:

> I have the opinion that animal experiments should be omitted from as many study programmes as possible. It is not acceptable the way it is now. I almost felt like an animal abuser during the experiments. I knew too little before carrying them out.
>
> I have worked with animal experiments previously but think that they are unnecessary, as much more training is needed to carry out procedures in practice. The theory is important, and perhaps somebody could have demonstrated some taking of specimens or something like that.
>
> In the laboratory classes, giving injections, cutting up, and suturing the rats we used were prioritised exercises, instead of learning how to handle and care for the animals, like taking them up from the cage and how to hold them.
>
> In my case, I found this animal lab completely meaningless. Animal experiments and labs should be entirely voluntary. You shouldn't be forced to do something that conflicts with your own values.

Leaving the students at Lund University, positive experiences are reported also from a biology major at Purdue University, who found her dissection experience worthwhile when she worked in the operating room at a nearby hospital. The situation obviously gave her opportunities to feel proud of the knowledge she had gained:

> My experience with the fetal pig taught me much about anatomy. Most of the human anatomy was just like that of the pig, only larger. I was often quizzed by the surgeons, and many of them were surprised that a premedical student with only one semester of biology could answer their challenging inquiries. (Quoted in Lewis, 1997 pp. 13–14)

Many students, regardless of their attitude to animal experiments in education, still support other students' right to choose, but Wang (2000) quotes a Cornell University student who is not sure that universities should be forced to offer alternatives.

This English and biology major student, initially positive toward dissection, feels doubtful about the educational value of the knowledge he gained from the exercises, although he has a lot of dissection experience:

> I had a long history of dissection during my elementary and high school years. I dissected my first frog with help from my father at the age of nine. I happily engaged in the standard 7th and 10th grade batteries of dissections, as well as dissecting in special classes for talented students in 8th and 11th grades. Looking back at what was taught and how it was taught, I can't help but suspect I learned far more about gross anatomy from the see-through flip pages of frog and human innards in the World Book Encyclopedia than I ever did from the actual act of dissection. (Quoted in Hepner, 1994 p. 150)

The following experiences are reported by a veterinary medical science student at Moscow State Veterinary Academy. The report reflects how students become desensitised to experimenting on animals, and the strong influence of professors on students' attitudes:

> I am now a 4th year student and I can see the difference in students' attitudes towards animals: in the 1st year of studying many of them couldn't even watch how [frogs were] being killed. Now, three years later, they find the experiment amusing. Some other institutes in Moscow even go out in the street to catch cats and stray dogs – and perform experiments such as unsupervised castrations and dissection on these animals. Mostly this change has [occurred] because of the influence of our professors who argue strongly that it is impossible to become a vet student without performing animal experiments. I don't believe that this is true, and moreover, most of the experiments are primitive ones such as putting frogs into scalding water or pouring an acid solution on to them. All the experiments are carried out on unanaesthetised animals, which sometimes scream because of the pain. (Maroueva, 1998 pp. 12–13)

This student of veterinary medical science at Norwegian College of Veterinary Medicine, Oslo, explains in detail her position on animal experiments, and what she regards as ethically sourced animals. This statement represents a category of students with a high level of ethical awareness:

> My position is the following: I do not want to cause animals suffering because of my education. This means also that I do not want to do experiments on animals, even if they do not physically suffer – as long as they are bought and kept in the experimental animal department only for the sake of the students. This is because I regard it as suffering to be kept in a sterile laboratory environment for one's whole life without ever

> having been outside, and with minimal opportunities for normal behaviour. ... Neither do I want to cause the death of an animal for the sake of my education. This includes dissecting animals bought for use of the students – even if this is only a demonstration (such as 60 students on one animal). However, I do not object to using slaughterhouse offal, and animals killed in the hospital – even in cases where I as a veterinarian would not agree with putting the animal down. On the other hand, I do object to using slaughtered animals which are bought by the school and would otherwise be eaten; and so-called 'surplus' animals (which might actually be ordered just for student use). The logic here is that I, as a student, do not want to create a market for killed animals. I do not create such a market, however, if I take animals or biological material from the 'garbage bin'. (Martinsen, 1998 p. 9)

The following statement formulated by a Swedish laboratory assistant student at the Polhem School in Lund when voicing conscientious objection, is another example of a student who has carefully motivated her position:

> I have been brought up to feel respect for suffering in both animals and humans, and for their right to exist. Holding a live animal in my hand and knowing that I will deliberately cause suffering and/or end its life, conflicts completely with my view. To me, conscientious objection is not about feeling discomfort with blood and everything that comes with it. It is for ethical reasons I have a strong will and wish to abstain from animal experiments. (Quoted in Persson, 1984 p. 8, author's translation)

The lack of information received prior to enrolling on her course of human anatomy and physiology is criticised by this student at Portland Community College in Oregon. Her situation tells about the strong reactions that can be evoked in students who have not been informed about the requirement to perform animal experiments:

> ... The course description never stated that non-human animal dissection would be an integral part of the curriculum, and nowhere could I find the college's pedagogical methods described. I had no idea that this kind of practice even persisted these days ... I was shocked. Never would I have guessed that as I continued my education in the field of health care for humans, on a course called 'Human Anatomy and Physiology', I would be expected to dissect a rat, cat, lamb or pig. (Powell, 1998 p. 21)

That vivisection exercises can be disturbing and traumatising for the student, is indicated by the following reaction from a student at a state university in the United States in response to a frog-pithing exercise (see next chapter):

> It was the most disrespectful, tormenting experience of my life. I spent almost half an hour in the bathroom crying. (Quoted in Balcombe, 1997c p.14)

Another student expressed criticism against the ill-defined objectives of vivisection exercises:

> Sometimes I wonder, after taking science at this school for the last 3.5 years, if this school wants us to learn something or if they just want to know if we have the stomach to kill. (ibid., pp. 14–15)

When the pupils in grade eight (14-year-olds) at the Bokelund School in Sölvesborg, Sweden, faced obligatory dissection of fish and a pig heart or a cow eye, they protested with arguments that can be defined as squeamishness (such as nausea), but they also expressed clearly ethically based concerns such as experimenting on and killing animals being wrong. Another argument that appeared was that it is completely unnecessary that all pupils in compulsory school are forced to carry out dissection exercises. (Roshäll Berthelot, 1999)

The American animal rights organisation People for the Ethical Treatment of Animals (PETA) receives many complaints from students upset about requirements to carry out animal experiments in their education. The quotations below illustrate how poorly performed experiments can be very disturbing to the students:

> I am in pursuit of my Doctorate of Pharmacy degree ... I have serious concerns about the anesthetic state of the rabbits we are operating on ... In the first lab, one group [of students] killed their rabbit with an overdose of [the anaesthesia] [sic H.P.] urethane. They got another rabbit which then ended up on a respirator to keep it alive to finish the experiment. Today another group started cutting open the neck of their rabbit before they realized it was not properly 'under' ... That night I was in tears again just thinking about it. (Quoted in PETA, 1999)

> The biology department at my institution uses frogs in their anatomy and physiology course. The students are required to dissect frogs that are ALIVE and remove their hearts while they are beating. The frogs are then thrown out. The frogs are anesthetized, but sometimes so weakly that they regain consciousness during the low-tech surgery. (ibid.)

> We had to cut open live baby turtles and pour solution on their hearts, then cut out the hearts and test various chemicals on them. They told me the turtles were 'brain dead', but, when I poured one solution on the turtle he lifted his head and gasped. (ibid.)

> Over the course of a month, three baby roosters are injected daily with a steroid dissolved in sesame oil. The purpose is to observe and record the effects ... Our steroid chick developed huge muscles, too heavy to be supported by his immature legs. The chicks couldn't move. They cried in pain. They dreaded every morning when we would arrive to shoot them up. I'll never forget those tiny black eyes that seemed to plead with me not to take them from their cage. (ibid.)

A biology student at Universidade Federal de Santa Catarina, Brazil, reports about a 'dog lab' in 1997, which also indicates how negligent conditions during the experiment can cause a negative learning experience:

> It's important to know that in a semester before this one, in the same experiment, the dog just regained conscience [sic] and started to scream. At this moment, a student started to cry, and many were leaving the lab at this point, in shock. The professor just forced them to stay at the lab, saying: 'You have to see this! It's a physiological process! Stay calm! We can apply more anesthesia!' (Tréz, 1999)

A former student who has graduated with a degree in philosophy and minors in biochemistry and nutrition, intended to become a nutritionist when she started, but changed her major after experiencing what she describes as 'the antiquated and callous attitude' within both the nutrition and biochemistry departments:

> Two memories in particular haunt me. In a human metabolism class we were forced to feed a live rabbit, then slice her open to observe the digestive process. I was absolutely appalled, and horrified that I was being asked to perform such an educationally meritless and horribly inhumane task. I left the lab and changed my major. Just prior to this experience, during a microbiology lab students were inoculating guinea pigs with some infectious material. The guinea pigs were squealing and I picked one up to try to comfort him while the lab instructor shaved his back. I thought I could calm his cries, but my efforts were futile. I still see the fear in his eyes. (Quoted in Hepner, 1994 pp. 140–141)

The wastage of surplus animals not needed for the laboratory exercises is criticised by this student, who at the time was studying for a zoology degree at London University. Her report also shows how the concern about pressure from educators to take part in animal experiments can be so strong among students that they do not even dare to communicate their arguments:

> ... One thing I found extremely worrying was the complete wastage of un-used animals, particularly amongst the higher vertebrates. With the pigeons, for example, very few students wanted to perform the dissection, so people were working in groups of 4 or 5 per animal. Enough animals had been killed so that there would be one between two students, so at the end of the day the un-used were just thrown out. Even those who did perform dissections said that they had learnt very little from them. I found that the majority of students saw dissection as something they had to do in order to fulfil course requirements. Some were so worried about talking to tutors about their views on dissection that they continued to tow [sic] the line, so as not to risk losing marks and jeopardising their degree. One student in my year decided to give up zoology after the first year and change to botany simply because she couldn't face the pressure she thought would be put upon her to dissect. (Johnson, 1991 p. 3)

This student, majoring in environmental science, recalls disturbing dissection experiences from her high school biology class. Her story exemplifies reactions similar to the emotion management strategies outlined by Solot and Arluke (see above, p. 38 ff), and explains why she did not object to the exercise:

> First of all, I have tried dissection. In my high school biology class, we paired up in partners to dissect fetal pigs. At the time, the idea revolted me, and I somehow knew it didn't seem right, but I wasn't really into school enough to feel like objecting. I did the whole thing, with a numb, disgusting [sic] feeling, like I was watching myself do it and that I wasn't really cutting. ... It was hard to tell anything in the pig. My one awful memory from this was in the callousness of my teacher. He seemed to smirk over the whole thing, like some sadistic voyeur. I remember him mentioning to the class, toward the end that you could get extra credit for cutting open the head. I remember the two boys next to me, cutting off the head from the body and ramming scissors through it, and parading it around the desk, like a demented puppet, with the teacher (who [sic] I'm supposed to respect?) watching playfully with a grin. Altogether, it made me feel awful and disturbed and I regret being silent. (Quoted in Hepner, 1994 pp. 142–143)

In a letter to the HSUS, one Connecticut high school student recounted a similar experience. This situation also gives associations to the findings of Solot and Arluke of disrespectful behaviour and gender-stereotypical behaviour as a manner of coping with the dissection situation:

> When the long, miserable week [of frog dissection] was over, the class was allowed to 'do as you wish' with the remainders of the bodies. So all of the boys broke bones, tore off body parts, tossed them around – it was absolutely horrible. I can still hear the bones of those poor souls breaking and cracking. I had nightmares. (Quoted in Balcombe, 1997c p. 14)

This college student, majoring in biology and English, also has unpleasant experiences and expresses how the pressure felt by the students prevents them from voicing objections. Again, emotion-management strategies seem to be used among the students:

> I went to the lab and quickly felt the disgust swelling inside. I could not watch the demonstration we were supposed to follow. I was sickened by my classmates'/friends' ability to manipulate the animal, some were enthusiastic, some made jokes, others were as sickened as I but performed the dissection anyway. Instead of expressing their apprehensive feelings, they tentatively completed the lab, the grade being more important than how they felt. (Quoted in Hepner, 1994 p. 151)

A community college student of applied science, wanting to become a nurse, reports that in order to get through the dissection, she had to harden herself so that she did not see the cat as a once living creature. She concludes with saying that she 'passed the course, but looked back on it with remorse and disgust'. (ibid., p. 166) Objectification and de-animalisation of the dissection specimen has obviously occurred in this case.

A Pennsylvanian high school student expresses the ethical problem she came

across when discovering the condition of the specimen given to her for dissection. Her story raises questions of the ethical awareness and responsibility of the educational institution:

> ... One day it was my turn to make the incisions, the stomach of our monkey had always looked larger than the others, but never in a million years did I think that anyone would be cruel enough to use a pregnant monkey for dissection. That was the last day I ever went back into the dissection room. Students hardly learn anything from [dissection] at all – I know I didn't. (Quoted in AAVS, 1990)

An experience that raises similar questions is reported by another high school student, also from Pennsylvania. Both cases show that factors such as the condition and source of the animal used also can generate negative learning experiences:

> The cat that I dissected [in advanced biology] was a pregnant cat with foot pads that were obviously not those of an outside cat or stray. She could have been someone's pet, and this was very disturbing to me. I can honestly say that I learned very little from this class and considered it a total waste of the cat's life. In my opinion, no student should be required to participate in [dissection] in order to pass the course. (ibid.)

Looking back on her education in veterinary medicine, this Dutch student reports that she now has her own animal practice and is doing fine without having had the experience of carrying out harmful animal experiments during her education. She bases her arguments on the desensitisation problem, and also on the advantages of alternatives such as clinical practice:

> I think you can become a perfect vet without doing any animal experiments. You can use animals that are put to death because you can't heal them, and a lot of experiments you can replace in this way. I think even surgery you can learn better from a veterinarian than from doing an animal experiment because then you see the whole surgery, the whole operation, and you see the animal recover. ... I think that if you do animal experiments you care less about animals, I think you will be acting differently towards other animals. and maybe towards people too. So I think it is harmful to do animal experiments – you are not as respectful towards animals as you should be. (Quoted in EuroNICHE, 1999)

Another student motivates her preference for alternative methods by the possibility to repeat experiments, go back and forward as she wants, and work with it by herself. (ibid.)

In Finland in 1987, the Ministry of Education received an appeal from student organisations to reduce animal experiments in education on the following grounds:

- The planning of the experiments and the students' insight in the experimental methods is insufficient.

- There is not enough time in the courses to teach students how to handle the animals.
- Time and animals are wasted to ascertain self-evident phenomena.
- The curricula are not scrutinised; old-fashioned methods are used year after year.
- In some universities, methods that are stressful for the animals are used year after year, in spite of the students' protests.
- The knowledge gained from the experiments does not justify the fact that the animals lose their lives.

  (JvWS, 1993)

As can be seen from the above quotations and references, students have various reasons for objecting to animal experiments. Some may find killing animals for any purpose unethical. Others may object to the ways in which specimens are obtained, which may range from wild-capture, to breeding, to collection from animal shelters. Other students may have adverse physical reactions to working with live or dead animals. Students also express their reasons in different ways; many have well-developed ethical convictions and values as a basis of their arguments, whereas other students stress their emotional reactions, that they are simply nauseated by the exercises. As will be seen in the following section, these two reactions may be the factors that decide how the objecting student is treated by her/his institution: There is a possibility that the highly articulate student with ethically convincing arguments will be met with greater respect, while the nauseated, or 'squeamish', student will be denied the opportunity to opt out of the animal practicals, out of a belief that the latter is less sincere about her/his reasons and not truly acting out of moral principles. As Balcombe (2000a) remarks, squeamishness is usually perceived as a weakness, and it is also often seen as an inappropriate reason for a student to be excused from an animal experiment. The term has been used to demean non-objective thoughts associated with the animals, including feelings of revulsion or compassion. Offner (1993) illustrates the term squeamishness in the following way, at the same time presenting an attitude that can be associated with domination and values being imposed on students by the educational establishment (cf. the consensus/coercion discussion above, p. 61):

> ... People feel squeamish or funny about many new experiences in life. Some babies do not want to take their first bite of solid food; some people are afraid to fly in airplanes. It is the role of responsible adults in such situations to encourage them to 'try it', knowing that it is a safe and productive activity. I strongly feel that we, as the responsible adults in a society, should be encouraging students to try dissections. (Offner, 1993 p. 149)

It can be argued, though, that judging students on the basis of the distinction

between squeamishness and ethical convictions is a mistake. Balcombe goes on to say that perhaps squeamishness should be taken more seriously as a natural product of empathy for others, and as a signal alerting us to the possibility that we are dealing with a problematic activity. Hepner (1994) develops this point in saying that squeamishness may be a sign of ethical disturbance, a response to a stressful situation that results from a felt violation of moral principles. If one looks upon the issue in this way, squeamishness may have ethical grounds, and the two reactions are intermixed rather than separate. The difference is then more likely to lie in the student's individual way of expressing her/himself, than in the reasons for objecting (bearing in mind that younger students may not yet have had the opportunity to develop an awareness of ethical values).

The Handling of Students' Objections

As mentioned in the beginning of this chapter, the student who expresses objections to performing animal experiments faces a number of risks, as objecting usually means going against the established norms of the institution. The way of meeting such objections varies greatly between institutions depending on their policy concerning conscientious objection, and also between individual professors and teachers, depending on their personal view on the issue (which is of great importance as the authority to decide on alternative assignments often lies with the individual instructor). There is also variation among institutions regarding the control they give students in dictating what they are, and are not, comfortable with. (Lewis, 1999) As we have seen, on the extreme negative end of the scale students will drop out, change majors, or abstain from even considering a career in the life sciences due to concern about the attitudes they may meet, the conflicts that may arise, and the struggle they expect to have to go through for their ethical beliefs. There are even examples, in Europe as well as in the United States, of students who have (successfully or not) taken their universities to court for their treatments.

In an ideal situation (in case animal experiments are still the norm of the institution), students are properly informed about their possibilities to voice conscientious objection, are met with respect for doing this, and are offered an educationally valid alternative without risking penalties such as receiving a lower grade. This 'ideal' case does not always occur. If at all allowed to opt out of the

animal lab, students might be left to learn the necessary materials from the textbook alone. (ibid.) Another, fairly common response from the instructor when being faced with a student raising objections, is the message that the student may watch a dissection without having to do any of the cutting, which indicates that the idea of 'squeamishness' seems to be widespread among educators. However, for many students this is not an acceptable alternative. What constitutes a viable alternative will vary between students, but a bonafide alternative is one that will involve no contact, either direct or indirect, with the animals obtained by the institution for experimental purposes. (Balcombe, 1997b) Using animal cadavers or tissue from ethical sources may be another possibility.

In a far-less-than ideal situation, students may be subjected to pressure from educators to make them change their mind about animals as a learning tool. It even occurs that the students' ethical values are questioned if they are not vegetarians or if they wear leather shoes. (NSMPD, 1997) There may also be attempts to marginalise the issue by telling the student that she/he is the first one ever to ask for alternatives, indicating that the majority of students do not share these ideas. There are cases when conscientiously objecting students have been explicitly asked by their instructors to change courses, or even to quit university studies altogether. It is not clear whether or not a majority of educators are inclined to feel that they should control the decision of whether students should perform animal experiments or not, but the educational establishment's value of its right to academic freedom could be a reason for reluctance to recognise the right of choice for conscientious objectors. Teachers who support and use animal experimentation in education appear to view objecting students as disruptive and rebellious, and as a potential disturbance to the class order. An educator's reluctance to accommodate a student may also be attributable to a fear that capitulation to one conscientious objector could open the floodgates to a deluge of other objecting students. (cf. above, 'Conceptual Framework') (Balcombe, 2000a)

Pressure can also be applied on the student in more indirect ways. It has been reported that in 22 U.S. medical schools, refusal to attend live-animal labs hinders an individual's chances of admission or promotion through the school's programme, even though these labs are not mandatory. In another example, a student at Boston University Medical School attended an optional rabbit vivisection lab because he saw professors become hostile to students who asked what the alternatives were. (ibid.)

Some students report about the lack of routine at the institution regarding conscientious objections, having being directed to person after person within the

university establishment without being given proper instructions on how to proceed. (Hepner, 1994) The burden of finding alternative assignments appropriate for each course may also be placed upon the student, but the proposal may then well be disapproved of by the instructor. (Martinsen, 1997) Even if granted an alternative means of study, the student may still be 'penalised' in various ways, such as being ignored by professors (Francione and Charlton, 1992), or being subjected to testing procedures which are more difficult than those for the other students. (Breslin, 1996)

In North America alone, tens of thousands of dissection- or vivisection-related conflicts occur each year in middle schools, high schools and universities. (Balcombe, 1997b) The situation and the various problems a conscientiously objecting student may face are illustrated below by a few personal reports from various parts of the world. There are of course also teachers and institutions that show great respect and support for the ethical concerns of their students, but here the focus will be on the more problematic cases, in order to stimulate discussions of how the relationship between the individual student and the educational establishment can be improved. The focus is on the individual student's experience of the situation, for reasons outlined in chapter 3, section 'Quality of Education'.

In his fourth year of biological science and geography studies at Eotvos University, Budapest, this Hungarian student was facing dissections and other experiments on frogs, mice, rats and cats:

> At the beginning of that year, along with a fellow student I told our practice leader that for ethical reasons we [did not] want to perform animal experiments. We spoke out publicly in front of our fellow students. The professor was angry, but didn't respond with a definite 'no'. However, he told the head of department who tried to persuade me and [my classmate] not to object to the experiments.
>
> We were waiting for a decision on our objection, and near the end of the semester the [head of department] told us that we would not be given a mark for the practical. This meant that we could not continue with the biology branch of our studies – and therefore our chosen career paths. We went to everybody to try and influence the decision: all influential people at and around the university, including the dean. After many 'negotiations' it was decided that instead of participating in 12 practicals, we would have to do only one. This one experiment was a frog practical: an investigation of the heart of an anaesthetised frog.
>
> We were in a terrible situation: why was it necessary to sacrifice that frog? ... Both of us decided that we would perform that one experiment. (Karatson, 1998 p. 7)

This is a report from a veterinary medical science student at Azabu University in Japan, trying to avoid the killing of healthy animals in experiments in her third grade:

> ... The teacher of Lab II was different from that of Lab I. When I expressed my opinion to the teacher this time, she became angry and said, 'If you boycott even one lab, I'll never give you a credit! So you can't become a veterinarian'. I was very shocked by her words. After all, I had already attended the live-animal labs twice against my will. During Lab II, I sat at a distance from the experiment and did not touch or look at it: I just waited for the experiment to finish. I still feel pain and regret whenever I recall that lab. (Nakano, 1998 p. 18)

This student at the Norwegian College for Veterinary Medicine in Oslo has the following experiences:

> At first we were four students who wanted to refuse the frog nerve/muscle experiment. Two professors had a meeting with us. Their attitude turned out to be very different from that of the anatomy professors. They delivered all the usual arguments from the necessity of touching a 'slimy disgusting' frog preparation to the outstanding well-being of the animals used. However, they agreed to look at SimNerve, which was provided by us through the EuroNICHE Alternatives Loan System, and we also delivered a written application for getting exemption from taking part in animal experiments.
>
> After some time both professors gave their reactions. They thought the computer program was not good enough, and boring. We also got a written reply stating that they insisted on us doing the experiment. We sent a letter of complaint, offering suggestions for a different alternative: Sim-Muscle in combination with a student experiment that was being done in the physiology course at the biology faculty.
>
> A long time passed and we did not get an answer to our complaint. Finally I was approached by one of the professors, telling me that they had reached the final conclusion. This was the same as before. They did not comment on the new suggestion on alternatives. One also told me that I would face a hard time having the opinions I have. He said I would have to do the experiments or take the consequences. I asked if they would force me to act against my conscience, and if so, on what grounds? He said that they do not force me, they give me a choice. I asked if that means a choice between doing animal experiments or quitting veterinary school. His answer was yes! I told him that this was a serious matter for me and that I would appreciate the answer in written form. At first he refused, but I insisted upon this, and after some time we received a letter in which the professors said that they were not willing to evaluate any more alternatives this year. (Martinsen, 1997 p. 10)
>
> I am still working to get my exam validated, and I am not sure what measures I will have to take. As the physiology professors seem to be unwilling to change their minds, my next move is to approach student organisations, the college board, and eventually the [Ministry] of Education, with my information on alternatives and my request for a humane education. (Martinsen, 1998 p. 17)

The attitude described below has been faced by a student majoring in environmental conservation at a university in Pennsylvania:

> ... I told him [my advisor] about my dilemma and he actually had the nerve to laugh at me and told me not to be so squeamish, and that zoology was a required class and that there was no way to get out of cutting up animals, after all I didn't have to actually kill them. Well, after he told me this I pressed my issue more by letting him know why I was

> ethically opposed and that I felt that alternatives were so much better to learn from. He then started to get visibly upset, I could tell by the stern tone of voice he used and his now stiff, upright posture. ... The speech proceeded with him asking me if I would watch while my partner performed the dissection. Of course I had to decline this unreasonable offer and he said that if I didn't dissect a frog, then someday when I'm working for Greenpeace and saving a baby sperm whale, I won't know how to save it because I didn't perform the dissection. He then went on to say that I had two options left, they were to change my major, or quit school. By then I was very distraught, I couldn't quit school, and I couldn't do what I came here to do. (Quoted in Hepner, 1994 p. 144)

Students' Rights

From the standpoint of the United States' legal system, Professor of Law Gary L. Francione defines whether a student has a right to refuse to participate in the use of animals as part of a course requirement as a *civil rights* issue. This argument is based on the free exercise clause of the first amendment to the United States Constitution (along with similar provisions in state constitutions), that protects freedom of religion ('religion' denoting not merely a traditional, recognised, or theistic religion, but also a sincere belief system addressing some 'ultimate concern', such as reverence for life). The civil right of a student to be free from state coercion and infringement on her/his 'religious' freedom, can thus be interpreted in a manner that makes it applicable on cases of conscientious objection. If the student has a valid free exercise claim, she/he is entitled to a non-animal alternative to dissection or vivisection. When a student in the United States has filed a lawsuit against her/his school, it has usually been on the grounds that the student's first amendment rights to freedom of religion have been violated by a requirement that the student participate in an activity she/he finds unethical. (Francione and Charlton, 1992) Seven U.S. states have implemented laws that allow students a choice regarding dissection exercises. (Balcombe, 2000a)

The right to conscientious objection is supported also in other national legislation: In 1993 the Italian parliament passed a law that grants the right of any citizen to refuse to participate in any form of animal experimentation, without penalty, and in India, a decision to make dissection optional for school students was implemented in 1998. (ibid.)

As seen in section 'Attitudes and Feelings Among Students' above, students almost universally support another student's right to choose alternatives to animal experiments, and this includes students who themselves have no personal objec-

tion to the use of animals as a learning tool. An example of a teacher statement of this right of students is presented by Petr Vaculík at Charles University in the Czech Republic. His view is that alternative procedures should be made available for those students who do not want to do experiments on animals, and that this should be a matter for the personal decision of the student, without pressure from teachers. Thus, at the beginning of courses, all students should be allowed to choose between the classical animal experimentation approach and the use of alternative methods. The two approaches should be run in parallel, and the accreditation system should accept those who have not performed experiments on animals during education. Furthermore, students should be informed about animal experimentation, i.e. what kinds of animals are involved, what suffering is likely to be incurred, and what benefits to science have resulted from such studies. They should also be informed about alternative ways of conducting experiments and about alternative methods. They should understand the need for proper design of experiments and of the importance of good analysis of the data produced. (Vaculík, 1994)

The right to information, as described by Vaculík above, is of special importance in this context. This is the most basic requirement a student can make, and should be of equal importance even in cases where alternative methods are not offered by the institution. Information should include whether exercises that could be ethically controversial are included in the curriculum, whether alternatives are offered, and the routines for voicing conscientious objection.

Moreover, information given to the students should be neutral, that is, not biased towards any of the approaches. However, the previous sections indicate that such information is often lacking. In Swedish legislation, authorities are obliged to give information, guidance, advice and other assistance to individuals in issues relevant for the authority's area of activities. Assistance shall be given to an extent appropriate with regard to the character of the issue, the individual's need for assistance, and the activities of the authority. In addition, questions from individuals shall be answered as soon as possible.

The lawyer Gunnar Tholander, commenting on this legislation, stated that the correct interpretation of the law is that the authority, *without request from the individual*, should assist her or him in looking after her/his interests in relevant issues. This means that in the case of conscientious objection, Swedish students have a right to receive all information, guidance and assistance needed about possibilities to carry out alternative assignments. (Söderlund, 1990) Söderlund's study of conscientious objection at Lund University found that information is

generally given to the students, even if some shortcomings were found in the communication process between the institution and the students. From the students' point of view, the information should be more extensive. Among the educators, their obligation to give information was largely unknown. (ibid.) In 1999, Stockholm University's student magazine *Gaudeamus* wrote that if any module of a course or study programme includes animal experiments, this should explicitly be stated in the curriculum. The objecting student does not need to suggest any alternatives, as this is a responsibility of the responsible educator. If the institution does not offer alternative solutions, an application for exemption from the obligatory module can be handed in by the student. If this application is rejected, the student can submit an appeal against the decision to a special board (*Överklagandenämnden för högskolan;* Board of Appeal for Higher Education). (Cele, 1999)

In their investigation of students' possibilities to voice conscientious objection, the Swedish Ministry of Education rejected the right of students to be exempted from ethically sensitive exercises in higher education, partly on the grounds of what is described as the principle of autonomy (*autonomiprincipen*), or voluntariness in the choice of study programmes. The investigation states that as the student autonomously decides whether to apply for a certain study programme or not, she or he always has the possibility to find out more about the contents of the modules prior to applying, and can choose not to apply for a study programme that includes, for instance, animal experimentation. (Utbildningsdepartementet, 1994.) The investigation does not mention the institutions' obligation to give information and assistance. There are several Swedish cases where information on the possibilities to voice conscientious objection is clearly lacking from the institutions' side. (Söderlund, 1990) The investigation places the responsibility to find information entirely on the individual student, which obviously contradicts Tholander's interpretation of the law. To receive extensive, unbiased information, not only upon explicit request from the student, is important also bearing in mind the fact that not all students have fully developed ethical standpoints before entering higher education. It would be desirable for these students to be given an opportunity to define such standpoints with the assistance of the institution in the form of early given information, as complete and unbiased as possible, and when the courses have begun, in the form of discussions of bioethics as an integral part of education.

The zoology student at London University, quoted above (p. 58), has a quite different viewpoint on the issue of 'free choice' for the students regarding applica-

tion for various study programmes. She states that reluctance to perform animal experiments should not be a reason for students to avoid studying life sciences, arguing that the only way for compassionate students to generate a change within the university establishment (and in the long run, within research) is to voice their opinions after being accepted on the course. (Johnson, 1991)

As already mentioned, policies regarding conscientious objection differ widely. In a survey of colleges and universities on this issue in the United States, many institutions reported on informal policies of offering alternatives to conscientiously objecting students (which does not necessarily mean that they guarantee a student's right to an alternative.) Informal policies, however, can fade and change depending on the professors or other key persons within the institution. (Lewis, 1999) A minority of American educational institutions have formal dissection-choice policies, but these are more rare in postsecondary education, seemingly on grounds similar to the 'principle of autonomy' expressed by the Swedish Ministry of Education. Balcombe (2000a) finds this dearth of policies unfortunate, as a good policy can benefit both student and teacher: Students know their rights from the outset, and potential problems are recognised early so that last-minute negotiating is avoided. A policy also helps students to obtain alternatives regardless of their comfort level on confrontation with professors. (Lewis, 1999) As an example, the Austin Independent School District in Texas has drawn up 'Guidelines for the Use of Animals in the Classroom', which state, in part: 'Students who oppose using animals must be given meaningful educational alternatives, including computer programs, videotapes, physical models, etc... Students must not be penalized in any way for refusing to dissect an animal.' (Balcombe, 1995)

The situation differs within Europe as well. The cases of Italy and Sweden have been described. In the Netherlands, the Ministry of Education and the universities (and comparable educational institutions) have agreed upon the possibility for all students with conscientious objections to use alternatives to animal experiments in education. The Dutch Act on Scientific Education states that teachers should offer alternatives to students when the examination committee recognises the conscientious objection of the students. (Every faculty has its own examination committee and these review the study programmes.) Despite these statutory regulations, in practice there are many teacher-student conflicts arising when teachers try to persuade students into doing the animal experiment. (In the Netherlands, an average of 2% of all students in the life sciences refuse animal experiments because of conscientious objections.) (Boerma, 1997) To take another European example, Norway has no law supporting the right to conscientious objection, and the fate of

the student lies mostly in the hands of the teacher. (Martinsen, 1997) Even where there are laws and policies concerning conscientious objection, they often have loopholes, and there may be problems of implementation and enforcement: Teachers are not always well informed, and there is little to stop determined instructors from applying subtle pressure on their students to participate in animal experiments. (Balcombe, 1996)

When students object conscientiously to animal experiments, their cases are usually resolved without any resort to legal action. Occasionally, however, a student has filed a lawsuit against her/his school. Legal case history in the United States indicates that the right of a student is usually upheld in cases of conscientious objection. The first time a student made a legal challenge to required dissection exercises was in 1987. Jenifer Graham, a California high school student, was told by her school to either dissect a frog or accept a lowered biology grade and negative evaluation on her school transcript. (Balcombe, 2000a) In 1988, the court ruled that the state education system does not require dissection for preparation for admission to California colleges or universities. (Orlans, 1993) Finally, the school agreed to reinstate Jenifer's grade and to remove the notation from her transcript. The case resulted in California's choice-in-dissection law. It also generated widespread publicity and set the stage for additional lawsuits and enactments of law in the United States. Maggie McCool, who refused to dissect animals in her New Jersey high school biology class, sued the school in 1989 for giving her a fail grade and declining to let her use alternatives. An out-of-court settlement required the school to recalculate Maggie's grade without the dissection labs and required a statement in the student handbook that students with religious objections to dissection be provided with alternatives. Jennifer Kissinger, a third-year veterinary student at Ohio State University, sued her school in 1990 for refusing to allow her to use alternatives to labs that cause harm and death to healthy animals. Jennifer faced expulsion from the university's veterinary programme at the time she filed suit. She won her case and was provided with an alternative curriculum for which she used cadavers, then assisted with and later performed surgery on sick or injured animals. Safia Rubaii, a medical student at the University of Colorado, sued her school for not permitting her to use a humane alternative to its terminal dog lab. She left the school to complete her training elsewhere. The courts ruled in her favour and the school was ordered to pay her $95,000. (Balcombe, 2000a)

Successful legal challenges from students have taken place in other countries also. Birgit Vollm, a human medicine student at the University of Frankfurt, took

her university to court for not giving her a certificate for the physiology course after her conscientious objection. Birgit referred to her personal freedom of conscience, but also to the animal protection law. The court gave more weight to her freedom of conscience than to a professor's freedom of teaching, but the university did not accept this decision and took the case to a higher court, where Birgit won again. (Vollm, 1998) Veterinary student Andrew Knight at Murdoch University in Western Australia took legal action through the state Equal Opportunity Commission after losing marks for refusing to participate in several physiology laboratory classes which used animals. As a result, his marks were restored (Knight, 1999), and in 1998 Murdoch University adopted a university-wide policy formally allowing conscientious objection and agreeing to review humane alternatives for all teaching units that use animals. As a part of the argument against the school, Article 18 of the Universal Declaration of Human Rights, proclaimed by the United Nations General Assembly in 1948, was cited: 'Everyone has the right to freedom of thought, conscience, and religion; this right includes freedom to change his religion or belief, and freedom, either alone or in community with others and in public or private, to manifest his religion or belief in teaching, practice, worship and observance.' (Balcombe, 2000a)

Students' Possibilities to Influence

Students have possibilities to influence their situation and the policy of their institution without going to extremes and taking legal action. In fact, a change of the institution's direction toward more humane teaching and learning methods is in many cases brought about by students themselves. Because today's students are naturally more computer-literate than those of any other generation, they are a powerful force for change. (Balcombe, 1997a) Non-animal models such as the SimSeries virtual physiology labs and Microlabs for Pharmacologists were developed by teachers responding to student conscientious objection. At the Institute of Physiology at Marburg in Germany, the whole class refused to perform the animal experiments, and today the SimSeries simulation alternatives are used there instead. (Jukes, 2000) At the pharmacology course for students of human medicine at Karolinska Institute in Stockholm, the animal labs were completely omitted from the curriculum, due to heavy student resistance after a transition period during which the students could choose between the animal labs and cell culture labs. (Brodin, 1990) Also in the human-medicine study programme as a

whole, the use of laboratory animals has decreased as many students have questioned it. (Dock, 1999)

In Finland in the 1980's, the students of medicine at University of Helsinki were criticising animal experiments which they had to perform in the pharmacology course. This resulted in the worst experiment being replaced by a video. At University of Joensuu a group of biology students appealed with success to their teachers for the reduction and refinement of animal use in teaching. At University of Kuopio the entire Students' Union demanded that the students should have the right to refuse to do animal experiments, and their demand was taken seriously. (Pennanen, 1997)

In Hungary in 1991, a petition for humane education at Eotvos University, Budapest, was signed by more than 100 students of biology, chemistry, geography, and psychology. As an indirect result of the petition, practically all students who did not want to vivisect had the opportunity to avoid it. (Karatson, 1998)

Russian students have co-operated with an animal welfare centre in getting the curricula of veterinary, medical and biological institutes to include the subject of bioethics, the aim being to explain to students that animals are sentient creatures with certain needs, and that they are able to suffer. The Ministry of Education in Russia agreed to include it in the curricula of the institutes, and it was introduced in 1998. (Maroueva, 1998)

After a 'dog lab' in a human physiology course at Universidade Federal de Santa Catarina, Brazil, three students took action and stole (!) the dog. The action gave rise to three conferences on animal use in education, and after this, the dogs were replaced by videos in the physiology course. Also in some other courses the dog lab and other animal experiments have been omitted. A few disciplines at the university still use animals, but fewer than previously, and the tendency is towards total replacement or elimination of these practices from the curriculum. (Tréz, 1999)

In the United States, students provide the greatest impetus toward more humane education curricula. (Balcombe, 1993) One example is that an alternative to the dog lab at Harvard Medical School was introduced after a first-year student took action together with the Physicians Committee for Responsible Medicine. (PETA, 1999) Most or all dissection choice laws and policies in the United States are due to students who have spoken out about their objections to dissection. (Balcombe, 1997a) The policy of Sarah Lawrence College in New York was adopted as a response to student concern over animal experiments. The guidelines drawn up by the Austin Independent School District, mentioned in the previous

section, were initiated by the student Lauren Sullivan with the help of animal protection organisations. A student who protested against the insensitive handling of dogs in a veterinary-technology course at the State University of New York in Canton was the impetus for humane refinements in that programme. A fitness leadership student at County College of Morris in Randolph, New Jersey, was granted alternative assignments to cat dissection, and a course was developed specifically for students who oppose dissection. At James Madison University and College of William and Mary, both in Virginia, positive changes have been generated by students in co-operation with animal welfare organisations; in the first case, the use of animals in the vertebrate physiology class was made optional and a new class section added that does not use animals. In addition, a new course on issues in animal welfare was offered. In the second case, the biology professor agreed to draft a policy offering alternatives, after students stated that they would like to have a choice between alternatives and dissection. (Balcombe, 1995)

Even when student protests do not generate immediate and concrete reforms, they may raise general awareness of the issue and initiate a dialogue about the use of animals in education which in itself has a great value.

CHAPTER 5

Animal and Environmental Aspects

As the animals used in experiments do not themselves have the ability to express their view on their situation, this part of the study naturally differs from the preceding two sections in that arguments and attitudes are expressed indirectly by human beings speaking from the animals' perspective. To what extent animals are capable of experiencing pain and suffering, whether animal suffering actually takes place in laboratory classes, the sources of animals used for educational purposes as well as ecologically related problems with animal experiments in education are examples of issues that are examined.

Conceptual Framework: Our Relationship to Animals. Theories of Will, Interest, Consistency, and Kinship

The way animals are treated in education (and in other circumstances) is determined by human beings' attitude to them. In chapter 1, the development of animal experimentation as a scientific and educational method in Western society and the rise of the anti-vivisection movement was summarised. Today, the situation is perhaps more complex than ever before, with a number of different views competing about how animals and animal use should be looked upon by society. Here follows a brief outline of some examples of such views and positions being debated today, their moral justification and the philosophical arguments behind them.

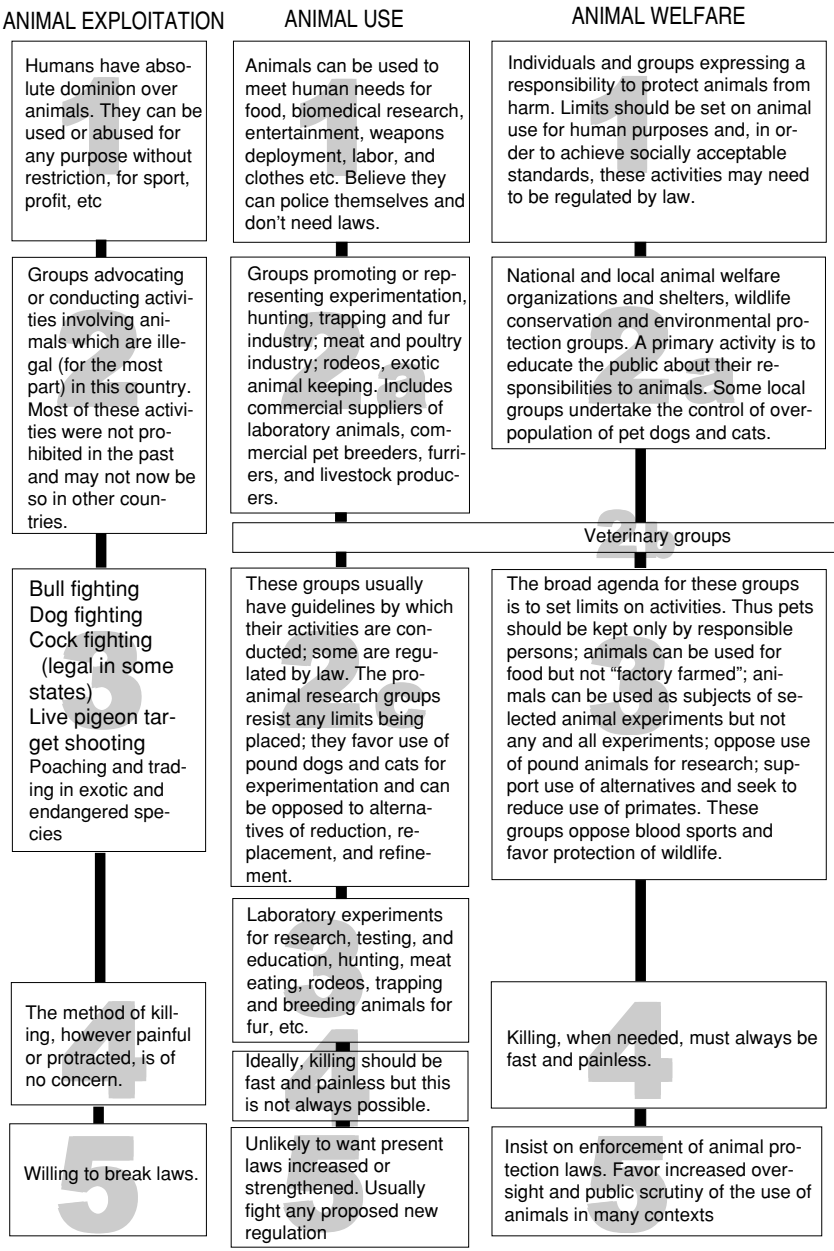
The physiologist Dr Barbara Orlans (1993) has classified current human attitudes to animals in Western society into five major categories, based on a concept of Katherine Morgan in 1986 (p. 92–93 below). The categories highlight the differences between major points of view, and the box numbers in the figure

refer to (1) statement of belief, (2) groups represented, (3) activities, (4) attitude to killing, and (5) attitude to the law. At the one extreme are the *animal exploiters*, who believe that animals are our property and we can use them as we wish, and at the other end are the *animal liberationists*, who hold that illegal and even violent actions are justified to prevent or stop animal suffering. At each end of this spectrum people are willing to break the law. The other groups identified are *animal use*, *animal welfare*, and *animal rights* supporters. In reality, the categories overlap since such attitudes are a continuum. Nevertheless, there is a polarisation of views that often over-simplifies the picture. The animal users and animal exploiters are commonly treated by their critics as a single group (portrayed as insensitive persons who use animals as tools), while all those who espouse animal welfare, animal rights, and animal liberation are forced into another group (portrayed as anti-science and anti-intellectual terrorists). But adjacent groups in the figure do not necessarily share a closer perspective than those more distant. For instance, a great political divide separates the animal users from the animal welfarists. Scientists who espouse the animal welfare perspective can suffer rejection from the scientific community; they are perceived as having 'gone over to the other side'. Also, with varying degree of intensity, the animal rights activists and animal liberationists attack not only the animal exploiters and animal users but also the animal welfarists for their more moderate stand on issues. This tendency of polarisation between science versus anti-science when it comes to animal experiments in education, has partly been illustrated in chapter 3. Orlans (1993) suggests that an explanation of this tendency may be that the retention of these educational exercises to some people represents part of a fight for the defence of animal experimentation as a whole.

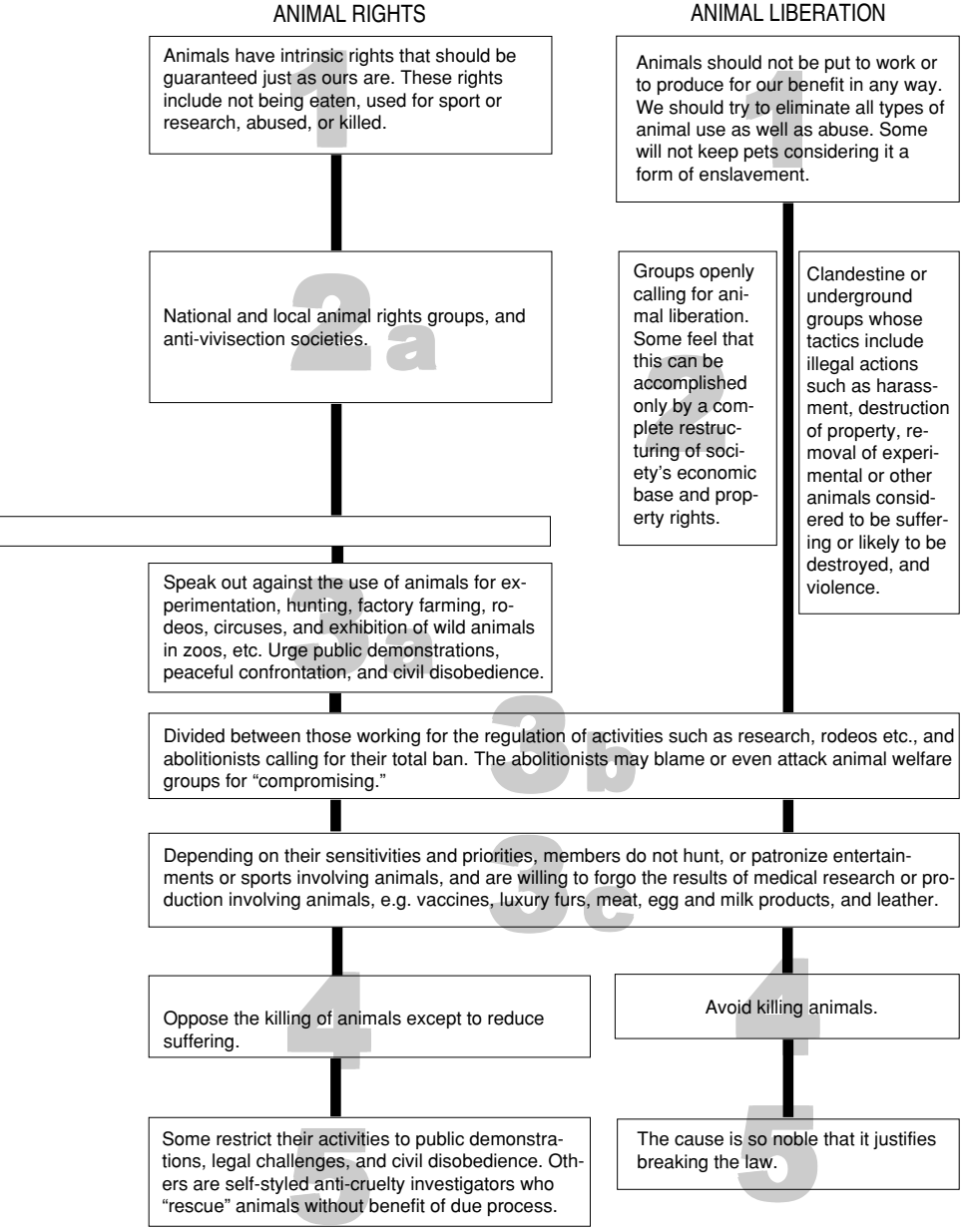
Underlying the above categories are a number of theories, put forward over recent decades when moral views about animal use have been much debated. A consensus is yet to be reached on who or what has moral standing and what is the nature of the moral relationship between humans and animals. (ibid.) Here, the *will theory*, the *interest theory*, and the *consistency theory* will be outlined. In addition, the *kinship views* of Mary Midgeley and a similar model by James Serpell are presented.

The views favouring animal experimentation rest primarily on important distinctions that separate humans from animals and emphasise human superiority. It is argued that these distinguishing features are morally significant so that humans are justified in killing and harming animals for human purposes. (ibid.) For instance the will theory, in its classical form as given by Emmanuel Kant,

Attitudes to Animals: An Overview of Animal -



Related Organizations. A Preliminary Classification



would define a 'right' as a capacity to obligate others to a duty. Possession of a right carries with it an authorisation to use coercion to enforce the correlative duty. This, in turn, implies that the right-holder's capacity is a power of discretion, either to enforce or waive the right. A right is therefore something that a right-holder may choose to exercise or not. The choice itself will be an act of will. This theory discourages efforts to attribute rights to animals, since animals can not be said to waive or exercise rights. In this way, all references to animal rights have to be translated into talk of human duties. (OTA, 1988) According to this view, animals have no moral standing and the generous treatment of them is just a matter of human benevolence.

The philosopher Carl Cohen has a view that supports these ideas. He claims that animals lack certain capacities and therefore have no rights. These capacities include the ability to respond to moral claims, the capacity to comprehend rules of duty, and the capacity to recognise certain conflicts between what is in their own interest and what is just. Cohen's view is that animal experimentation is justified, virtually without restriction. (Orlans, 1993)

The interest theory, as put forward by the utilitarianist philosopher Peter Singer, rejects the Cartesian view that animals are without sensations. Animals are argued to have feelings, desires, and preferences and their moral status should be based on their capacity to suffer or experience pleasure (a capacity that may vary between species). (ibid.) The capacity to experience suffering and pleasure is central to the interest of an individual, and since this is found in both human beings and animals they ought to have their interests equally considered. Since the utilitarian principle holds that the total amount of suffering should be minimised, actions and policies are to be evaluated for their effects, for good or ill, on everyone, not just the individual alone or some select group of individuals. (OTA, 1988) This, however, does *not* mean that animals are equal in moral status to humans, only that equal harm should be counted equally and not downgraded for animals on the sole basis of the fact that they belong to a different species. Singer uses the term *speciesism*, analogous to racism and sexism, to denote failure to accord equal consideration to equally significant interests, and states that to discriminate on the basis of species is fundamentally the same moral mistake as discrimination on the basis of race or sex. (Orlans, 1993) In an article by Gilmore (1991), the educational system is identified as one of the three major root causes of speciesism (the other two being historical sources such as religion and philosophy, and developmental sources such as childrearing). In his view, students have been conditioned since their developmental years to feel natural about animals being

used as tools; for food, clothing, entertainment, research and so on. Consciously-informed decisions about this pattern, free of the bias of longstanding habit, rarely occur, and is usually not enhanced by schooling. The existing pattern is instead reinforced by pressures of social conformity. Gilmore argues that the school setting fosters speciesism in young people in a plethora of ways, an example being authoritative requirements on students to perform animal experiments.

The consistency argument, put forward by deontological theorists like Tom Regan, rejects the ability of rationality, freedom of choice, and self-awareness as conditions for having a right to life. (OTA, 1988) Regan's position is further based on an ideal of non-intervention in the lives of other creatures. (Brennan, 1997) According to this view, animals are 'subjects of a life' just as human beings are, and a subject of a life has inherent value in the sense that they are ends in themselves. This inherent value is not respected when animals are reduced to being mere tools in a scientific experiment. Thus, to conduct any animal experiment is morally wrong, no matter how much humans may benefit from the results, because the animal's basic right to respectful treatment has been infringed. Regan establishes a strong set of boundaries to protect weak and vulnerable subjects. He holds that special protection should be accorded to vulnerable groups of human beings (such as the mentally disabled and infants). (Orlans, 1993) Given that these persons lack capacities of rationality, freedom of choice and self-awareness, like animals presumably do, Regan also points to the inconsistency of holding both that this capacity is a condition of having a right *and* that *all* humans and *only* humans have moral rights. In this respect, animals and certain human beings fail to qualify as moral agents (lacking moral duty, as they are unable to choose freely among impartially determined moral alternatives). But they do possess other capacities, such as preferences and an individual welfare of their own, which give them an inherent value that give them standing as moral patients – that is, individuals on the receiving end of the right and wrong actions of moral agents. They have this value equally, and equally with moral agents, and it gives them a claim, or right, to certain treatment. (OTA, 1988)

Another philosopher, Mary Midgeley, makes the case that the extent of our concern over living creatures is related to our sense of kinship with them. This idea can be likened to a series of concentric circles around a human being, each further and further afield. First there is the individual's family, then personal friends, followed by colleagues, tribe or race, non-human primates, other warm-blooded vertebrates, cold-blooded vertebrates, invertebrates, and other living things. In general, the more distant the circle, the less the sense of kinship. The kinship view

asserts that we have stronger obligations to our own children and other family members than to strangers; that we have stronger obligations to our own community as a whole than to other communities. Similarly, we tend to favour our own kin and our own species over the lives of other animals.

This model builds on Darwinistic ideas of a continuum of life forms, rather than an absolute division between human beings and animals. Although the understanding of similarities between humans and animals has gained ground over time (it has been established, for instance, that chimpanzees and human beings share 98% of their genetic material), the issue is still emotionally laden. There seems to be a concern that following an upgrading of the moral status of animals will entail an automatical downgrading of human beings. (Orlans, 1993)

A similar model, built on 'familiarity' or 'closeness' instead of kinship, has been developed by Serpell (1989). Thus a person is more inclined to behave altruistically towards those who are familiar (relatives, friends, neighbours etc.), and feels probably less inhibited about harming complete strangers or known enemies. According to Serpell, closeness can be defined in a variety of ways, such as biological resemblance, intelligence, recognition of similar feelings, motivations and needs, rewarding social interactions (e.g. pets); 'cuteness'; and other qualities. The closeness model is dynamic rather than static. Through social contact, interaction and observation, there is a tendency for distant categories of individuals to drift closer and become less distant. Knowledge of others tends to promote empathy and understanding leading to an increased sense of responsibility. The implications of this process are that, if an individual ultimately intends to harm another, he must either have some way of absolving himself of responsibility, or he must take steps to prevent the victim becoming too familiar in the first place. Techniques of this kind, detachment processes and objectification of the animals, are widespread among people who use animals in harmful ways. They were also included in the coping strategies of schoolchildren during dissection exercises in Solot and Arluke's study described in chapter 3 (p. 38 ff).

Infringements of Animal Interests

If an 'interest' is defined in terms of capability of suffering, mentally or physically, there should today be little doubt that most species used for experimental purposes possess an interest in not being caused pain or distress. Science itself has shown that all vertebrates show behavioural responses to pain. Pain reception requires

some cognitive capacity, and is affected by emotional states. Anxiety potentiates pain, and neurochemical prerequisites for experiencing anxiety have been found in all vertebrate species studied so far, including fish. In addition, legislation regulating animal experimentation in various countries often acknowledges animal suffering. (Langley, 1991) In recent decades, scientific understanding about the nervous systems of humans and animals has vastly expanded. The work of scientists in various disciplines has demonstrated in animals capacities that previously were thought to be uniquely human. These capacities include complex communication systems, culture, consciousness, use of tools, the practice of deceit, reasoning ability, pain perception, and suffering. It is now recognised that the perception of pain and the capacity to suffer extend further down the phylogenetic scale than was previously thought. Expressions similar to those of human beings in response to pain, and also other manifestations of suffering, are found in other animals, especially other mammals. In addition, the pain-detection threshold is relatively similar throughout the mammalian species, including humans. Thus, pain exists among warm-blooded vertebrates, and among some, if not all, cold-blooded vertebrates. Pain *may* exist down to insect level; anaesthetics appear to be effective right down to this level. Other forms of suffering exist at least in the higher vertebrates. (Orlans, 1993)

If an animal is capable of suffering, it is presumably also capable of experiencing pleasure. This should also be included in the 'interest' definition, and consequently, it lies in an animal's interest that it has an interest in not being killed, as killing an animal (even humanely) will exclude it from all future possibilities of experiencing pleasure. Untimely death is the ultimate deprivation, the ultimate loss of opportunity to find satisfaction, and the ultimate infringement of an animal's interest. (ibid.) Furthermore, possibilities to exercise a natural behaviour is also part of an animal's interests, acknowledged for instance by the Swedish animal welfare legislation.

Thus, animal interests include some negatives (things to be avoided), and some positives (desirable things that should be present). Among the negatives are: not to be afflicted with physical pain or mental suffering; not to be killed; not to be harmed by fear, held captive, confined, or immobilised; and not to be captured from the wild and separated from family and social group. The positive interests of animals include freedom to choose where to live, and ability to establish territorial rights; freedom to express the natural range of behavioural repertoire common to that species, such as social interaction with their own and other species; freedom to select preferred food; enough space to be able to express all forms of natural

movement such as stretching, walking, running, rolling, and swinging; and freedom to be able to escape harm and to make other self-determining choices. (ibid.)

It is more problematic to establish scientifically whether animals have moral rights or not, and this is a discussion which falls outside the scope of this thesis. Having established, though, that animals have interests, this fact will be the basis of this and the following sections.

When an animal becomes the subject of an experiment, some or many of its interests are compromised or obliterated. Determining the infringement of an animal's interests is very complicated. Examples of factors to be taken into account when deciding whether or not an animal is harmed in any way, and if so how much, are the severity and duration of the pain or discomfort inflicted, infringement of other animal interests involving, for example, confinement and death, and the place of the species on the phylogenetic scale (with simple organisms with little or no sentience at the bottom end, and highly developed mammals such as primates at the top). A number of category systems, so-called 'pain scales', have been developed in various countries in order to facilitate assessing the degree of animal suffering in experiments, but the extent to which these systems have been adopted varies. Other systems of classifying animal experiments, including one specifically designed for the use of animals in education, have also been proposed, but none of these has been widely adopted. Systems to assess animal pain may, for instance, be based on behavioural signs involving posture, vocalising, temperament, and locomotion, and clinical signs of the cardiovascular, respiratory, nervous, and musculo-skeletal systems. Other points that may be considered are whether the animal is conscious throughout the procedure, the use, duration, and potential risks of anaesthesia, procedures involved in the preparation of the animal, type and duration of restraint, and so on. (ibid.)

When it comes to suffering in general (not only pain), there are a number of variables that can be sources of stress to an animal: temperature, noise, crowding, light, darkness, air quality, restraint, methods of handling, fear, disease, etc. In our current state of knowledge, however, it is impossible to know exactly what mental capabilities animals have. We do not know to what extent, if any, they have a sense of the future. We do know that certain non-human primates can plan current strategies in order to obtain food in the future, but we do not know whether any species of terminally ill animals have a sense of impending death. We assume that animals, unlike humans, are not aware of certain things, such as the purpose of being in captivity or the purpose of what is being done to them in an experiment.

Presumably animals are limited in their ability to suppress or enhance the perception of pain based on a comprehension of the total situation. They probably lack a broad view of an event. (ibid.)

To some extent, the recognition of suffering in an animal (or in a human being) depends on the sensitivity of the person observing it. Suffering that is obvious to some may be denied by others. (ibid.)

Treatment of Animals in Education and Training

It has been argued that the amount of animal suffering involved in dissection has been exaggerated. Balcombe (2000a) outlines several such arguments. One example presented alludes to the billions of animals killed for meat in the United States and notes that the use of animals for research and education constitutes only about 0.3% (24 million) of animal consumption. Balcombe further refers to arguments put forward by members of the American Association for Laboratory Animal Science in 1992, who exempt dissection from regulatory concern because of the belief that it does not involve animal pain or distress. It is also pointed out that there are worse fates for animals consumed for other uses than for those harmed for education, where they are 'generally handled with far greater solicitude and care.' Also quoted by Balcombe are arguments published in *Journal of Mammalogy* in 1993, claiming that those who breed animals to kill them are promoting the interests of the animals: 'None of these [dissected] animals would be born if not wanted, and they have a quality life and die humanely rather than live nature's torturous life. From the standpoint of a quality life, the need for this resource produces an improvement of life for some individuals of these species.' (quoted in Balcombe, 2000a p. 38) Lord (1990, p. 330) takes another perspective on the argument that animals do not suffer, asking 'Why does not the dissection of a flower or seed arouse the same sympathies in dissection opponents as the dissection of a frog or rabbit?', implying that animal dissection is the moral equivalent of plant dissection.

It has also been argued that live animals used for teaching are not subjected to pain and distress because the procedures are generally carried out on anaesthetised animals, which are euthanised during anaesthesia, and that euthanasia of animals using universally acceptable techniques is generally not considered an ethical problem. (Hagelin, Carlsson and Hau, 2000) However, with the discussion of animal interests in the previous sections as a background, the humane killing of an

animal for experimental purposes also should be considered a harm caused to that animal. In a 1986 survey reported by the Universities Federation for Animal Welfare in Britain, methods of killing experimental animals in educational institutions included chloroform, ether, dislocation of the neck, suffocation with carbon dioxide, stunning and in the case of cold blooded animals, freezing. (BUAV, 1990)

Some of the student quotations presented in chapter 4 indicate that animals are not always subjected to painless experiments in education and training and are not always treated with respect by students and instructors. It obviously happens that animals are improperly anaesthetised, regain consciousness during the procedure, or die before or during the experiment. Besides, not all procedures are terminal: Surgery practicals in medical and veterinary school can involve recovery from the anaesthetic (Orlans, 1993), and physiology experiments in veterinary medicine education may include the study of metabolism during different temperatures; experiments in which mice are starved and used, but not killed. (Martinsen, 1997) In this section, some other examples of harmful use of live animals in education will be given.

Two common animal physiology exercises involve observations and manipulations of the muscles of live frogs and the hearts of living turtles, respectively. For the purposes of these exercises, the animal is first rendered brain-dead by pithing, usually performed by inserting a sharp object such as a dissection probe through the base of the animal's head, thrusting it into the braincase, and moving it about to scramble the brain. (Balcombe, 1994) An alternative way of performing frog pithing is to insert one blade of a pair of scissors into and across the mouth of a (live and fully conscious) frog and slice off the top of the head. Following pithing, the gastrocnemius muscle (large calf muscle) of the frog is dissected out of the body and hooked up to an electrical recording device so that various aspects of muscle response to electrical stimulation can be observed and recorded. In the turtle-heart lab, a turtle is pithed, then the plastron (undershell) is removed with a circular saw so that the living heart can be observed. Various chemical compounds are applied directly to the heart to observe stimulating and retarding effects on the heartbeat; the vagus nerve (tenth cranial nerve) in the animal's neck may also be manipulated to observe the effects on heart function. (Balcombe, 2000a)

The most recently available statistics from the Canadian Council on Animal Care, reveal that 300 animal experiments reported under the heading of 'Education and Training of Individuals in Postsecondary Institutions and Facilities' in Canada in 1996 were classified in the category of causing severest pain. Comparable animal use practices occur in the United States, even if this sort of data is not

available there. Such a course is taught in Ohio State University's microbiology department. The course, entitled 'Principles of Infection and Host Resistance', has capacity for up to 125 students per year. In 1995, five invasive animal labs in the course required the following experiments:

- 20 rabbits given Freund's complete adjuvant and bled via intracardiac puncture. (Freund's complete adjuvant is an emulsion used to immunise animals, that sets off an inflammatory reaction which can result in intense pain)
- 20 mice killed by cervical dislocation (neck breaking), then dissected to obtain bacterial slides and swabs from abdominal organs
- the lethal bacterium *Streptococcus pneumoniae* injected into the stomach cavities of half of a group of 135 mice (the remainder were injected with a saline solution as a control); mice observed every 48 hours for ill effects
- 250 mice each receive four injections into the stomach cavity over a four-week period; all are exposed to the infectious bacterium *Salmonella typhimurium*; all mice are killed in this lab
- 65 mice are injected twice with the infectious bacterium *Staphylococcus aureus* (ibid.)

In introductory psychology and behavioural biology courses, laboratory exercises in rat behaviour are common. Several procedures commonly associated with these exercises are stressful for the animals. They may, for example, be deprived of food and water in order to enhance the performance of some tasks, and are forced to perform during the daytime, when they would normally be inactive. (HSUS, 1986) Some experiments involve starving animals; for this procedure one biological supply house provides nine different deficiency diets and appropriate test animals to let students observe various forms of malnutrition. (Russell, 1996) Nutrition studies involving live-animal experimentation have occurred quite commonly in U.S. pre-college classrooms. (Balcombe, 2000a)

U.S. high school students perform invasive live animal experiments at 'science fairs', described in chapter 2 (p. 21). Historically, the conditions during which these experiments were carried out were below acceptable standards and animal suffering was high. The experimenters (teenage students) were novices with poorly developed skills; their knowledge of anaesthetics was faulty or entirely absent; their equipment could be defective and unsterilised; and supervision was cursory or non-existent. Experiments were carried out after school hours, sometimes in the students' homes: basements, bedrooms, and garages were common sites. Since the 1960's, the rules for science-fairs projects have been tightened up, but rules allowing young an inexperienced students to inflict pain and suffering on animals

remain. (Orlans, 1993) Current rules permit teenagers to induce traumatic pathological conditions in vertebrate species, providing they meet some conditions. (Orlans, 1995) Pregnant animals as the subject of toxicological studies, aiming at studying the deformities and death of the new-born, have gained wide popularity. (Orlans, 1988b) Another example of harm-inflicting science-fair projects is a 1989 prize-winning project that involved burning hamsters with an electric soldering iron. 28 animals were used; the purpose was to observe burn healing. (Orlans, 1993) A 1999 science fair included projects that had teenagers injecting animals with cancer cells, nicotine, high doses of antibiotics or amphetamines, or exposing them to radiation. One million American students participate in science fairs yearly. (Balcombe, 2000a)

Naturally, young, inexperienced students lack adequate technical expertise to ensure an appropriate standard of performance in science-fair projects such as those mentioned above, or in other live animal experimentation procedures. Sometimes teachers also lack this expertise (Kelly, 1980), and even if they do not, it might be difficult to maintain a strictly controlled experimentation situation in a student laboratory, especially with younger students. This has been shown by Solot and Arluke's study presented in chapter 3. That problems occur also when older students are involved is indicated in chapter 4, and it sometimes seems as if these problems are not solely connected to a lack of technical skill. Petr Vaculík at the Department of Physiology of the Medical Faculty at Charles University in the Czech Republic, reports on experiences with the problem of students' improper treatment of laboratory animals: 'As one student commented, 'Some students used high dosages and even antagonistic drugs, not to acquire the knowledge, but for their own pleasure'. This is an extreme example, but such students undoubtedly do exist.' (Vaculík, 1994 p. 41)

It happens that not only students, but also teachers, step beyond what is regarded as proper treatment of experimental animals. One recent case involved a U.S. high school principal taking science students into his garage, where they killed and dissected cats. In another case, two Indiana high school students shot a puppy and took it to class to dissect after the teacher had instructed them to bring in a specimen of their own. The killing of animals was banned at a school in Wyoming after biology teachers slaughtered pigs on the school grounds. At an Ohio school, a biology teacher was charged with cruelty for killing piglets by bludgeoning them at his farm (one of his male students then bashed a still-living piglet against the pavement in the school parking lot after the teacher brought piglets to the school). (Balcombe, 2000a)

It can be assumed that improper or illegal activities related to animal experimentation occur in educational settings also in other parts of the world. In Sweden, for instance, animal experiments have been performed in upper secondary education without permission from an ethical review committee. (NSMPD, 1998)

Conditions such as those outlined above are likely to add to the suffering and harm inflicted on the animals, in experimental situations which already in themselves (if performed properly) are unnatural, stressful or painful to them.

Animal Suppliers

The way the experimental animals have been treated before they end up in the student laboratory is a matter of concern regardless of whether they are to be used for dissection or for vivisection purposes. Supplying animals for experimentation is a large and thriving business. In the United States, at least 20 companies supply dead and/or live animals for use in education. Some of these companies are large and successful, selling a broad range of educational materials in addition to preserved/live animals, and some are small, family operations, which deal strictly with the supply of animal specimens. The largest U.S. company, Carolina Biological Supply Company (CBSC), which was started in 1927, employs approximately 400 people, has annual sales of more than $25 million, and reportedly doubles in size every six years. (Balcombe, 2000a)

In 1971, Gibbs et al. conducted an in-depth study to document the conditions of the capture and warehousing of frogs bound primarily for dissection. They found crude handling methods and negligent transport conditions. All of the frogs were captured in the wild (not raised as laboratory frogs). Most were kept alive between the time of capture and the time of shipping to the classroom or laboratory. In the summer months, most frogs were overheated and hyperactive often to the point of convulsion. Many of the frogs not initially crushed during the rigours of capture, transport, and shipping in sacks, died of starvation or disease in the unnatural and insanitary holding tanks. Since this study was published in 1971, there is little to indicate that conditions of frog capture, transport, and storage have changed substantially. Field investigations conducted between 1997 and 1999 by the HSUS suggest that the only significant change is that a much larger proportion of frogs is now killed before shipment to schools. (ibid.)

Rana Laboratories, a CBSC supplier in Texas, is representative of the HSUS'

findings. Rana purchases well over 100,000 pounds of leopard frogs yearly and an unknown quantity of bullfrogs. The animals are taken from wild populations, and kept without food during the holding period prior to distribution. Mortality rates during shipment can be high. The frogs are killed by dropping them into a solution of alcohol and water. The animals take 15 to 20 minutes to die. Immersion in alcohol is not mentioned by the American Veterinary Medical Association as a means of killing amphibians. (ibid.)

In 1989 the organisation PETA carried out an investigation at CBSC headquarters in North Carolina. Videotapes from the investigation show live cats arriving at the facilities in crowded wire cages. The cats are poked with a long metal hook from one cage to another and then into the gas chambers. The following observations were made during the investigation:

- up to 20 cats per cage in vehicles lacking ventilation
- a cat giving birth while being gassed
- a cat meowing after being gassed
- the movements of unborn kittens visible in the bellies of pregnant cats after gassing
- a live dog trying to crawl from beneath a pile of dead dogs in the back of a truck
- a rabbit, still breathing, being catheterised and embalmed
- shipments of live pigeons left on a loading dock for six and one-half hours in small cardboard boxes
- embalming of live frogs

The investigation also reports on insensitive behaviour on the part of CBSC employees:

- an employee spits on a rat after strapping the wriggling animal to a restraining device
- an employee laughs as a cat convulses after being hooked up to an embalming board
- a cat is bludgeoned to death by an employee after the cat bit him
- an employee deliberately prolongs the drowning of a rabbit by repeatedly pulling the animal from the water as it is about to drown
- employees play catch with a rat before drowning it

(ibid.)

Investigations of other animal supply companies have also been carried out. In 1989 Bonner et al. examined the supply of red-eared slider turtles for classroom

experiments. At Connecticut Valley Biological Supply Company in Massachusetts, turtles were observed being warehoused in crowded conditions, and exhibiting a range of maladies. In 1994, the World Society for the Protection of Animals discovered cats in Mexico being rounded up from the streets and killed by putting ten cats into a sack and drowning them or by affixing the sack opening to a car exhaust pipe. The bodies were embalmed and then shipped to the United States for school dissection. The company, Preparation of Animal Material for Scholarly Study, supplied dead cats (3,000 per week) and other species to several American biological supply companies. (ibid.)

In 1995 authorities raided a chicken farm in Mexico, and found 800 dead cats. Workers at this facility told health officials that the cats were killed by 'sticking a piece of wood in their mouths to keep them still and cutting their throats'. The cats were being shipped to the United States for use in school dissections. Similar operations were reported in other Mexican border states. (ibid.)

It is not certain to what extent these American findings are representative of procurement practices in the biological supply trade. They could be atypical cases, but there are also factors that suggest that inhumane practices are commonplace and perhaps routine in the supply industry. Such factors include the lack of regulatory oversight, closed-door policies on the part of the suppliers, and the potential for lack of humane care when living animals are to be sold dead. (ibid.) In biological supply houses, no economic incentive works in the animals' favour since they can be sold alive and healthy, diseased, or dead. (Orlans, 1993)

Apart from wild populations, there are other sources of animals for biological supply companies. One example is euthanised cat and dog carcasses from animal shelters. There are problems connected with this animal source as well. For instance, there is a risk that there will be less incentive to address the problem with pet overpopulation, if money is involved in the transfer of animal carcasses to the biological supply companies, and the transfer should not take place unless the animal's former owner has given consent to it. (Balcombe, 2000a) Some animal dealers are known to acquire under false pretences the animals they sell for dissection, posing, for instance, as 'caring new owners' for unwanted pets. (HSUS, 1997) There is also a suspected connection between pet theft and animals sold to biological supply companies by certain animal dealers. (Hepner, 1994)

Animals raised and killed in the meat industry are another source of dissection materials. Foetal pigs, removed from pregnant sows following slaughter and viewed as by-products of the meat industry, have become one of the most commonly used animals for school dissections in the United States. There are

serious humane concerns with this source of animals also. The conditions in which a majority of animals raised for human consumption live on factory farms today have been widely criticised as inhumane. Conditions of transport from farm to slaughterhouse are routinely bad, causing significant numbers of animals to die in transit. The abattoirs also cause great suffering to the animals at the time of slaughter. (Balcombe, 2000a) In Europe, especially, these problems have been revealed in several investigations, by authorities such as the European Commission as well as animal welfare organisations.

Classroom dissection of animals from fur farms, while less common, is no less problematic from a humane standpoint. Skinned mink, fox, and rabbit carcasses are available from biological supply company catalogues. Inhumane methods are used for killing wild animals for their pelts and for raising fur-bearing animals in captivity. (ibid.) Not all teachers seem to be well-informed about these conditions. (Lord, 1990) In Ireland, dead greyhounds bred for racing but not reaching the desired standard, have been disposed of and used for experiments in veterinary courses. The problem with this source is that breeding (or over-breeding) animals for entertainment and then disposing of them can be justified in the name of educational purposes. (Fitzpatrick, 1989)

When educational institutions purchase live animals or animal carcasses from the above mentioned sources via supply companies, they indirectly give financial support to these industries and their animal abuse. To many students, this would not be acceptable, even if the animals were not bred and raised primarily for experimental purposes. What constitutes an 'ethically sourced' animal should be carefully considered and discussed between educators and students.

Sustainability Issues

Apart from the harm caused to the individual animal when being captured and removed from its native habitat, wild-caught animals used for experimental purposes also raise ecologically related problems in that the collection of them contributes to the depletion of certain species, such as leopard frogs. For the use of high schools in the United States alone, approximately three million frogs are destroyed each year (not counting use at other educational levels). (Orlans, 1993) Gibbs et al. acknowledged in 1971 that the influence of frog-catching on the decline of frog populations cannot be considered negligible. Today, many frog populations are still declining and some have recently become extinct. Collection

for educational uses has been cited as contributing to bullfrog declines in both Canada and the United States, in 1990 and 1981 respectively. (Balcombe, 2000a) Many U.S. supply companies now order their frog supplies from Mexico, where collection costs are low. (Hepner, 1994) As frogs are key members of the ecosystems around the world, both as predators and prey, the detrimental effects of their overexploitation extend through the ecosystem. (Balcombe, 2000a) The decline of frogs may cause an increase in insect populations such as mosquitoes, and this in turn may have consequences for, among other things, human health. (Weil, 1996) One of the arguments for the recent decision in India to make dissection optional in schools, was that environmental balance is affected by the killing of frogs. (*Indian Express Newspapers*, 1998)

Frogs are not the only species on the verge of extinction that are used for educational purposes. The spiny dogfish shark is a small shark species that is considered to be threatened by overfishing, but it still remains a popular species for school dissections in the United States. At least seven U.S. biological supply companies sell this species. The total number of these fish sold for dissection each year has been estimated at 100,000. (Balcombe, 2000a)

The turtle, another commonly dissected animal in the United States, is another threatened animal species. Collection for dissection may be a significant factor for the decline of turtle populations. Adult, female, red-eared sliders, a popular turtle 'specimen', are removed from the wild at a rate of 100,000 yearly in order to replace breeding stock on turtle farms. (Weil, 1996)

There are arguments to defend the activities of biological supply companies. One educator claims that the colonies of animals kept by the companies '... are maintained in clean, healthful environments away from the ravages of the natural environment. With normal ecological controls removed, a very low mortality rate occurs. It is these environmentally naive and highly susceptible creatures that are sent to the biology classes for dissection.' (Lord, 1990 p. 331) However, there are also educators supporting animal experiments in education, who clearly state that endangered species should not be used in the classroom, or sold by biological supply companies. (Offner, 1993)

Another issue of environmental concern linked to animal experimentation in education, is that dissection of preserved animals usually involves a degree of exposure to formaldehyde. Used to embalm and preserve the dissected specimens, formaldehyde presents both immediate and potential long-term threats to the health of those participating in dissections. Formaldehyde (or formalin) is classified as a 'toxic and hazardous substance' by the United States Occupational Safety

and Health Administration. High concentrations of formaldehyde can cause permanent vision impairment if splashed on the eye, and prolonged exposure may result in respiratory impairment. Deaths from accidental exposure to high concentrations of formaldehyde have also been reported. (Balcombe, 2000a) According to Physicians Committee for Responsible Medicine (1996), formaldehyde is a suspected carcinogen. The human safety limit of formaldehyde has been placed at one part per million, which also is the odour threshold for most people, so if one is using formaldehyde and can smell it, then its concentration exceeds the acceptable level prescribed. Reportedly, many students who have dissected remember the odour of formaldehyde that accompanies the exercise, and students who dissect animals are often provided with little or no protection. (Balcombe, 2000a)

In an article by Toakley and Aroni (1998), the issue of sustainable development and the role of universities is discussed. They refer to the list of principles that was an output of the United Nations Conference on the Human Environment held in Stockholm in 1972, which included statements that natural resources should be safeguarded and conserved, and that science, technology, education and research should all be used to promote environmental protection. They also state that education about sustainability is vital in view of its importance to everyone, and that sustainability issues are not only technical, social and economic in nature, but there is also an ethical dimension. These factors will need to be taken into account by politicians, professional bodies, educators, researchers and religious groups in providing the leadership required to effect change. Education for sustainability must involve everyone, and take place formally in schools and institutions of higher education. University authorities can be encouraged to operate and develop the campus in a sustainable manner.

Considering the background of the use of animals for dissection and vivisection in education that has been shown in these sections, it is difficult to see how educational institutions where these exercises are carried out seriously can contribute to fulfilling the needs outlined in Toakley and Aroni's article. It further stresses the importance of ethical considerations and discussions in various respects at schools and universities.

CHAPTER 6

Concluding Discussion

Summary and Analysis

Animal experiments in education have a long history and are still widely used in practical classes at many levels (particularly in life-science education), and for a number of purposes such as demonstrations and illustrations of facts and phenomena, performing measurements, and training of various procedures. Animals are used although there are a number of pedagogical, ethical, and other problems connected to these methods, and although there are many sophisticated humane methods available today. The legislative situation differs widely between countries; in many cases animal use in education is not regulated at all. Similarly, statistical data on the number of animals used is often unreliable or completely lacking, but it can be estimated that many millions of vertebrate and invertebrate animals are used for educational purposes around the world each year.

The overall picture that emerges from the outline of aspects, attitudes and arguments of various stakeholders in chapters 3–5, gives an indication of the complexity of the issue of animal use in education. The rapid development of new ICT technologies and their use, and their influence on the way we work in other areas of education and (Western) society in general, does not necessarily mean a general acknowledgement of their benefits as alternative methods in laboratory classes in life-science education. This study points at a polarised situation in this respect.

Looking at strictly educational objectives, it seems hard to maintain the absolute necessity to use animal experiments in most areas, considering the potential of available alternatives, the numerous evaluation studies that have been carried out, and also considering the fact that animal experiments are often used inconsistently in equivalent study programmes. There are, however, various problems connected to evaluation studies: there are many factors that may influence the fulfilment of educational objectives, such as the attitudes and skills of teachers

and the design of the experiment. Furthermore, objectives of the classes where animals are used are not always clearly defined.

Courses in laboratory animal science and microsurgery training present some particular problems. The first case involves students who will be specifically trained for scientific work involving animal experiments, but alternative models in combination with supervised apprenticeship in a 'real' research laboratory is a learning approach that can be emphasised (when possible assessment problems have been solved). In the second case, which is microsurgery training, clinical practice may be less suitable, and fully adequate non-animal methods seem yet to be lacking. Until such alternatives have been developed, it might be justifiable to use carefully designed animal experiments, in spite of the fact that this training is not specifically aimed at training students to become professional animal experimenters.

How various teaching and learning methods contribute to educational quality is more complicated to assess (even though many alternatives can provide a number of characteristics and potentials missing in the animal model). In fact, what is perceived as quality is a quite subjective matter which can vary between stakeholders. Like the achievement of objectives, the achievement of quality may depend on a number of different factors that need to be addressed. A problem is that there is a lack of evaluation studies of long-term learning gains comparing different teaching- and learning methods and how these may affect a professional career.

Assuming that the student herself and the way she experiences and is able to use her education is central to the quality concept, a factor to take into consideration is what can be referred to as the *latent* or *hidden* curriculum, or the implicit messages conveyed through education. Applied to the issue of animal use in education, these terms are connected to the shaping of students' attitudes to animal use in science, and to the (intentional or unintentional) desensitisation of students to animal suffering (although not all educators agree about this issue). It can be viewed as a socialisation process of students into the scientific community, which sometimes starts at a very early age. It seems important to consider fully the implications of this factor, both with regard to the individual student to whom being forced into a situation where she/he has to deliberately cause harm to an animal can be a quite disturbing experience, and with regard to what attitudes and abilities the educational system nurtures in future generations of scientists.

Yet another implication derived from this context of the socialisation process is the influence of the educational institution's exertion of authority over the

individual student: More or less subtle means can be applied in order to make students conform with the prevailing pattern of order in the educational situation and system, effectively maintaining the *status quo* without having to deal with complicated ethical issues. The student's main tool to deal with this conflict of values is voicing of conscientious objection, but the extension to which this practice is officially sanctioned and used varies widely. In some cases student pressure has generated changes in the direction of more humane education curricula, but conscientious objection often requires a great deal of effort and courage from the individual student, and involves considerable risks such as receiving lower grades or being ignored by professors. The conflict that may arise has sometimes led to court cases, but more commonly, many students with ethical concerns about animal experimentation, especially at institutions without a formal policy on conscientious objection, choose either to conform, drop out, or simply not even consider a career in the life sciences. Again, this is a reason for addressing the question of what kind of scientists the educational system aims at producing, and whether part of this aim should be that some students (there are reasons to believe that the majority are female) are in practice locked out from careers in the life sciences because of their ethical values – especially when there are cases, like that in Sweden, where universities at present experience great difficulties in recruiting students to study programmes in the life sciences.

Looking more in detail at the attitudes and arguments of educators and students revealed in chapters 3–5, it seems risky to draw any reliable conclusions of predominant majority opinions from surveys carried out since most studies are quantitative and may suffer from superficiality. However, some tendencies can be seen in existing studies, such as that concerns about animal experiments seem more common among female than male students, and that many students support a student's right to choose alternatives even if they themselves do not mind performing animal experiments. It can also be suspected that there is a risk of eliciting biased information, as the researchers conducting the studies are likely to have a strong opinion on animal experimentation in education (which in part may be a reason for carrying out such studies). Qualitative attitude studies could add information and understanding, especially if carried out by researchers who do not themselves have a strong position on the issue.

When qualitative studies are lacking, actual statements and arguments of individuals, the way they are formulated, and the basis for their justifications can be examined. Beginning with educators, one commonly expressed concern is what is defined as the importance of the 'hands-on' experience, in short denoting a

conviction that no alternative can replace the sensory experience of actually handling a real animal. The main question here is whether this particular experience is necessary for the achievement of educational objectives, and how essential it is for enhancing educational quality. Again, considering the possibilities to combine alternative approaches, including clinical practice for more specialised students at higher levels, it is in most cases difficult to see how harming an animal solely for this purpose can be justified, especially as there appear to be few scientific studies to support this argument.

Arguments focusing on the stimulating environment of the animal laboratory that results in a different level of understanding and the student's true involvement in her/his learning, may be applied to some students, but obviously not to all. It could be discussed if this stimulating environment cannot be achieved in other ways, suitable for all students.

The cognitive aptitude of visual-spatial perception should not necessarily require animal experiments either, as 3-D principles can be conveyed through both physical models, three-dimensional computer modelling, and also through animal cadavers from humane sources.

Even biological variability can be provided by computer-based and other alternatives.

The argument that animal experiments would be necessary at lower educational levels in order to ensure a high level of scientific literacy in the general population seems far-fetched; no reason has been expressed why humane methods could not be used for this purpose, when they can fulfil objectives much more detailed and specialised.

Teachers supporting more humane approaches in laboratory classes often stress their advantages from an ethical point of view, but also point to various technical aspects which they relate to educational quality, such as repeatability, possibilities of adjustment to various purposes and needs, and possibilities of integration with other disciplines. These arguments indicate that the traditional animal model is considered an old-fashioned teaching method that cannot meet the needs of modern science education.

There is also a view that animal experiments are unnecessary, as education is not about finding new knowledge, but demonstrating already known facts. The lacking contact with the 'real' animal seems for these educators to be subordinated to the other benefits of alternatives that the animal model can not provide. That there may be a certain value for the student in experiencing an 'unsuccessful experiment' with a real animal (referring to the level of concentration and stress-

handling capabilities required) seems not to be considered by these educators.

The issues of desensitisation, the demands made on future scientists by industry, assumed preferences of students and what teaching methods are most cost-effective, are examples where quite opposite views can be found among educators. There are probably also a considerable number of educators who recognise the important benefits of the animal model and at the same time see it as an aim to replace it with humane methods, but these persons' opinions seem not to be published in scientific journals very frequently. It seems reasonable to make a connection here with suggestions expressed in the previous chapter; that the discussion about animal experiments in education also to some extent represents the discussion about animal experiments in science as a whole, and that this may add emphasis to the 'extreme' sides of the debate. Another difference between these two groups is that most educators positive to alternative approaches can be expected to have some past experience of animal experiments as well, whereas it is more doubtful whether most defenders of animal experiments have been exposed to modern alternative methods to the same extent. From this assumption, the arguments of the former category in general might be more well-founded, as these educators have been motivated to compare different teaching approaches more thoroughly.

Students positive to animal experiments in education (although material on this aspect is very limited) seem to stress, much like the positive teachers, the 'hands-on' experience as valuable for facilitating understanding of the educational content. Some also see it as necessary for a research or professional career (to some extent depending on the field in which the student will specialise). Some students seem to feel that they have no choice regardless of their ethical standpoint, and the familiarity with alternative methods seems generally to be low.

Students negative to animal experiments criticise a number of different aspects and often report on traumatic experiences in the laboratory classes (and in the situation of conscientious objection, when students are sometimes met by disrespectful or even hostile attitudes from educators). Causing suffering to sentient beings is a main concern for these students, but also the sources of the animals and the (lack of) skill and respect with which the specimens are treated are reasons for their objecting. The desensitisation issue is referred to by some. Not surprisingly, some students dismiss the educational value of these exercises completely, seeing them as a pure waste of animal life. Nausea or other physical reactions, often referred to as 'squeamishness' by educators, is a sign of disturbance in the student that may well have ethical grounds. Viewed from these students' perspective,

animal experiments effectively have a disruptive effect on important educational objectives.

Mixed feelings are expressed among students, for instance in the reaction to animal experiments as 'unpleasant but interesting'. Furthermore, the degree of acceptance of animal experiments may be dependent on the complexity of the species used, and whether the animal is dead or alive during the experiment.

The situation of the animals used for educational purposes may be criticised from several perspectives, such as the harm inflicted on them when they are collected or bred, transported, used and killed, and sustainability problems related to the depletion of certain species. This raises questions about ethical awareness in and responsibilities of educational institutions. Education is rarely value-free, and the inclusion of ethical discussions in the curricula is a way of dealing with this issue.

It can be noted that many arguments appearing in this study are difficult to judge in an objective manner. It is tempting to take educators' arguments in support of alternatives more seriously than the arguments of teachers favouring the animal model, as the former tend to refer to concrete, technical benefits whereas the latter refer to the more diffuse 'sensory experience' when describing the respective methods. Furthermore, a student with concerns about animal experimentation can be considered to be over-reacting, but if her/his emotional experiences are strong, they will undoubtedly affect her/his ability to gain anything from the learning situation. On the other hand, students who have not been exposed to alternative methods can not be expected to argue in favour of them.

Educators have a great responsibility to familiarise themselves with various teaching and learning approaches, to address potential problems and advantages connected to them and to discuss these with the students. Educational institutions have a responsibility to give students the possibility to develop a position and make a choice concerning matters of conscience.

Suggested Steps Towards a Humane Education

Looking at the above findings, there are numerous reasons for striving to replace animal experiments in education in accordance with the principle of the Three Rs (described in chapter 2, p. 22). In some cases, this principle is also supported in legislation. In particular at lower educational levels, there should be little doubt that harmful animal experiments could be replaced fairly rapidly without seriously

jeopardising educational aims and quality. As previously mentioned, students who choose to specialise in a few certain fields of the life sciences might for particular reasons need to be exposed to 'real' animal use, but these exercises should be performed at advanced levels and as far as possible in the form of clinical practice. In cases where animal experiments are still judged as being absolutely essential, they should be carefully designed, and students should be adequately prepared for them. As expressed by the ECVAM Director Michael Balls: Using an animal in an experiment should be regarded as a *privilege* – not as something taken for granted.

In spite of the fact that a wide range of alternative methods is available and used in education today, a number of problems connected to their regular implementation and acceptance emerge from this study. One problem is the lack of evaluation studies comparing the long-term learning achievements of students who have performed experiments with the animal model versus alternative methods. There are obvious complications with carrying out such studies, but a discussion of how this knowledge could best be achieved should be initiated. Such evaluation studies would be interesting also from the viewpoint that the effectiveness of the animal model in achieving educational objectives and quality has been generally accepted without being formally validated. General improvements of evaluation studies can further be made by including both content- and process-learning achievements. Another problem related to empirical research is the lack of qualitative attitude studies of various stakeholders involved in life science education, among whom the students themselves may be regarded as the most important group.

Increasing student influence over their education is another important issue. Individual institutions can achieve this by formalising possibilities of conscientious objection through a policy document, which has the additional advantage of decreasing confusion among students and staff as routines for such procedures are established and clarified. The policy should include principles for animal use at the institution. Student organisations should be involved in all discussions the institution undertakes about policies concerning teaching and learning approaches. The students should be informed about the policy at an early stage of the application procedure to the institution. To make proper use of a policy, unbiased information on different learning methods in combination with discussions on bioethics included in the curricula would provide a basis for students to make well-founded choices of experimental methods. Preferably they should also be asked to justify their position when deciding about a method in a particular situation. At lower

educational levels, humane education from more general perspectives should be integrated parts of the curricula.

Educators are crucial actors in this process. In order to convey adequate information to students and to prevent potential tendencies of conservative attitudes among educators, they need to become familiar with alternative methods at an early stage; preferably already during their teacher-training education. To facilitate this, the dissemination of information on alternative methods and discussions of their pedagogical merits and problems, as well as other problems related to their implementation, should be strongly promoted at institutional, national and international levels. Financial and career incentives for teachers and researchers to develop and adjust such models to various didactical needs must also increase at all these levels.

An endeavour to review and standardise the curricula of similar courses and study programmes in accordance with the principle of the Three Rs could generate improvements such as clearly defined educational objectives and agreements on the best ways to fulfil them, an increase in educational quality when experience of alternative methods are shared, decreased expenses and avoidance of double work if alternative approaches are jointly developed. Transnational projects involving developing countries with scarce resources, to enable them to invest in new pedagogical methods are of particular importance for this reason, and, in cases where the animal model is still considered indispensable, such projects could offer increased possibilities to bring down to a minimum the number of animals used.

Fundamental changes of policies and practices can be expected to take time at all levels. Certain political initiatives are necessary, such as requirements that educational institutions conform with guidelines in accordance with the Council of Europe's regulations (see p. 15 above). It would also be desirable to formulate time-scheduled strategies for implementing a humane education through the principle of the Three Rs, followed by necessary support in various forms. Co-operation and efforts at all levels are needed in order to make humane education a prioritized concern.

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InterNICHE – the International Network for Humane Eduction

We aim for a high quality, fully humane education in biological science, veterinary and human medicine. We support progressive science teaching and the replacement of animal experiments by working with teachers to introduce alternatives, and with students to support freedom of conscience.

InterNICHE is an open and diverse network comprising students, teachers and animal campaigners. The network focuses on animal use and alternatives within biological science, medical and veterinary medical education.

There is no membership, but free association around the issue of progressive, humane life science education. InterNICHE works in partnership with any individual, group or department that shares the common goals of replacement of harmful animal use and investment in high quality ethical science.

Amongst many national and international projects, InterNICHE has produced an award-winning video on alternatives, where teachers from a variety of disciplines demonstrate the alternatives that they use in their courses. This is now available in nearly 20 languages.

The forthcoming 2nd edition of *From Guinea Pig to Computer Mouse* is a book which fully describes over 500 products designed for progressive life science education. It also addresses teaching objectives in detail and assesses different pedagogical approaches.

InterNICHE is a non-profit charity which relies on donations and grants for its activity.

Visit our website http://www.interniche.org

NORINA

Database of Audiovisuals and other Alternatives

The Laboratory Animal Unit, Norwegian School of Veterinary Science, Oslo, has compiled an English-language database of audiovisuals and other alternatives for use in the biological sciences.

The primary purpose of the database is to offer an overview of possible alternatives or supplements to the use of animals in student teaching, at all levels from schools to university.

The database consists of approximately 3700 entries, (February, 1999) including computer programs, CD-ROMs, interactive videos, films and more traditional teaching aids such as slide series, 3-D models and classroom charts. There is also a section for Contact Persons who are developing and/or using audiovisuals at their institution, and for suppliers of audiovisuals.

We invite users, developers and suppliers of audiovisuals to send in details for future upgrades of the database.

NORINA is available free of charge at the following web site:
http://oslovet.veths.no/NORINA

european resource centre for alternatives in higher education

eurca

Aims of EURCA

- ✓ to actively promote the use of alternatives to using animals in higher education;
- ✓ to provide a mechanism for effective dissemination of useful information about alternatives to using animals in HE;

These aims will be achieved by:

(a) Establishing a Resource Centre - a collection of electronic alternatives and taking this to relevant scientific meetings in Europe where it would function as a drop-in advice centre for teachers.

(b) Assembling a group of academic teachers who actively use alternatives to take responsibility for disseminating information about alternatives to other teachers in the European community and to articipate in the activity outlined in (a).

(c) Creating a collection of alternatives and making these available to teachers

(d) Carrying out site visits to demonstrate good practice in the use of alternatives.

(e) Setting up an Internet website with an expansive information database on alternatives, demonstration versions of alternatives, evaluations, links to users etc.

Activities of EURCA

The planned functions of EURCA would be to:

- ✓ set up a content-rich web-based database of selected ('tried and tested') alternatives to using animals in humane education
- ✓ assemble a collection of quality alternatives (CAL, video, models, using humansrather than animals to teach experimental science etc) and make them available to teachers for evaluation
- ✓ actively disseminate information about alternatives by taking the resource centre to major international scientific meetings
- ✓ offer advice to teachers on good practice in using alternatives based on the experiences of teachers who have implemented alternatives at universities throughout Europe
- ✓ encourage and promote the findings of evaluative studies on the effectivenessof alternatives in humane education
- ✓ establish a European network of teachers actively using alternatives to share experience.

Visit our website **http://www.eurca.org**

> *Those in the 2nd year were much worse. Students and demonstrators killed sheep, guinea pigs, rats, toads and other animals in order to demonstrate scientific principles that have been established for years. The worst were in physiology, where groups of students anaesthetised sheep, then performed* [*vivisection*] *experiments on them. Procedures included cannulation of arteries and administration of various drugs to demonstrate effects on blood pressure, severance of nerves to demonstrate effects on heart rate, and forced inspiration of various gases to demonstrate effects on respiration.*
>
> (*Student of Veterinary Medical Science, Murdoch University, Australia*)

This documentary study deals with animal experimentation as a teaching and learning method from educational perspectives, student perspectives, and animal and sustainability perspectives.

In education, the primary purpose of animal experiments is not to come up with new knowledge, but to demonstrate and support learning and understanding of already known facts. The same experiments are often repeated year after year.

This emphasises the importance to consider replacing the animals (or animal tissue) with alternative methods for educational purposes. A number of alternatives are available today, and there is great potential for further increase in quantity and quality in the future.

Stiftelsen Forskning utan djurförsök

SWEDISH FUND FOR RESEARCH WITHOUT ANIMAL EXPERIMENTS

Gamla Huddingevägen 437, SE-125 42 Älvsjö, Sweden
Phone: +46 (0)8-749 03 40 Fax: +46 (0)8-749 13 40
E-mail: info@stifud.a.se http://www.stifud.a.se