Ethical rules for scientists; the ethical problems of GMOs

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If we want to understand ethics in science, we can start to ask ourselves three fundamental questions. “What is ethics?”, ” What is science?”, and “How are science and ethics related?”. They can be answered by many different ways.

What is ethics?

The concept of ethics falls into two main categories. The first category comprises notions having to do with morality, virtue, rationality, and other ideals or standards of conduct and motivation; the second, notions pertaining to human good or well-being and the “good life” generally. (Encyclopedia of Bioethics, pp. 796).

It is important to distinguish between ethics and other social norms, such as law, religion and politics.

Ethics is not a set of laws: some actions that are illegal may not be unethical (for example the speed limit/ transport someone to an hospital) and some actions that are unethical may not be illegal (lying is unethical, but only under certain conditions is illegal). Laws also can be unethical or immoral, for example the slavery in the USA in the 1800s. (Hart,1961 in (2)).

It is important to distinguish between ethics and religion too. The world’s main religious provide moral guidance and each of these books contains an ethic. Ethical standards of conduct do not need to be based on a particular religion, they can be justified without reference to any particular religion like Christianism, Muslism, Hinduism, Buddhism, Jewism.

Professions have their own ethical standards. According with David Resnik, the author of the *The Ethics of Science: An Introduction*, science should be viewed as profession. In the opinion of Shrader and Frechette (1994 in (2)) if it would be done that people who occupy the professional role “scientist” should adhere to professional standards as well as moral ones Professional standards function as a quality control mechanism for a professions’ goods and services and they help maintain publics’ trust in the profession.

Moral norms can also provide guidance for professional when their ethical standards conflict with each other or with other standards of conduct (David Resnik, 1998).

What is science? Science refers to a system of acquiring knowledge based on the scientific method, as well as to the organized body of knowledge gained through such research.

Science depends on the cooperation and coordination of different people to achieve common goals within a larger social environment (David Resnik, 1998).

Many different aspects of scientific research require this cooperation and coordination of different people, such as experimentation, data analysis, writing research papers and education future scientists (Grinnel 1992, in book 6).But science is more than a social institution; it is also a profession (Fuchs 1992, Shrader-Frechette,1994 in (2)).

Should science be viewed as a profession? According to the author's and ours opinion yes, it should.

Science has not always been a profession, but it has become more like a profession since the Renaissance (Fuchs 1992 in (2)). Science was not a profession during many eras. Science became a profession since Darwin and his publication *Origin of Species* (2). Important events happened between 1450 and 1850, like the "development of a scientific method, the establishment of a scientific society and scientific journals, the growth of universities and university-based research, the emphasis of science education at all levels and the employment of scientists in military and industrial research (…)" (Meadows 1992; Fuchs, 1992 in (2)) that led to the professionalization of science.

"Scientific profession" can be considered a general expression and it can includes many different scientific professions (geneticist, immunologist, astronomist…). Although there are many differences between these various scientific professions, there are important similarities too, which consists in part of professional standards and goals common (David Resnik, 1998).

How is science and ethics related?

Science's ethical standards try to protect the objectives of science, which is trying to achieve truthful knowledge and to give solution of practical problems.

With the scientific and technological advances in the global society appeared the great questions that led to the elaboration of ethic rules. Bioethics intends to clarify and to alert about the consequences of those advances, consciously of these fast progress in areas such biology and medicine and the need of assurance for the respect for the Human rights. "Bioethics is the

systematic study of the moral dimensions, including the moral vision, decisions, conduct and the policies, of the life sciences and attention to health, using a variety of ethical methodologies in an interdisciplinary set." (Reich, 1995 in (4)).

Being scientist and scientist as a person

Scientific research can be considered as a way to get the happiness; it offers to the researchers lots of satisfactions, like the opportunity to work with different people, explore new fields, and broaden their expertise in addition to the exhilaration of discovery.

They are part of a community based on ideals of trust and freedom, where hard work and achievement are recognized as deserving the highest rewards (3). Public know that their work can have a direct and immediate impact on society, because of the media. This fact can possibility the publics' interest in the findings and implications of research.

Every scientist is born in a society that educates him how to look at the world around him. If we think aboutthis we can verify that many opinions are passed from one generation to the next, generating in society an emptiness of personal perspectives. In general a scientist is subject to the same influences as everyone, but he is expected to be immune from this powerful cultural influence. At the same time, many skills are given by the personal experience and interactions. The same for scientific discovery curiosity, intuitions and creativity.

Science can be made with rigour, but designed under the light of the unconscious preconceptions of the scientist's time, even though in some cases the possibly collectable information would almost be the same as today. We can find an example for this; most of the american constructors of the Biodeterminism in the 1920's renounced to their own conclusions, when in the 1930's these Ph.D. had to join the soup of the poor- suddenly it was no longer possible to explain poverty through hereditary stupidity.

Nowadays there is a *Scientific Committee of the International Society Bioethics* (*SIBI*) that propose a set of observations and recommendations (Saul Semião-Santos, 2004), (Appendix 2). This Committee doesn't have executive power, in the way that doesn't make laws, but only make suggestions or recommendations to the governmental Bioethical commissions, that are in an

"inferior" pathway. This fact can be very interesting and can be determinant as a way as impossibility political games or economical interests.

So, scientists don't have a physic deontological code, like, for example, Doctors do. They reune in these Committee and discuss the questions with other scientist, but individually they also listen to their conscience and they follow the ethical rules of their specific activity, their speciality.

Further affield, many countries have national bioethics commissions, generally established by the government, which play an advisory role (Tor Lezemore, 2002).

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Standards of ethical conduct in science

Ethical standards in science have two conceptual foundations, morality and science. Ethical conduct in science should not violate commonly accepted moral standards and it should promote the advancement of scientific goals(David Resnik, 1998). The first three principles of scientific ethics: honesty, carefulness and openness. (David Resnik, 1998)

- values in science

It is a fact, that "Scientists bring more than just a toolbox of techniques to their work, they must also make complex decisions." They must have the capacity to relate multiple factors that can influence their wok.

"Many kinds of values come into play in science." Studies have shown that "social and personal beliefs (…) can shape scientific judgment in fundamental ways." For example, many scientists in the history of Science "favoured the notion of a God" and were influenced "as much by them religious views as by them practical observations." "The history of science offers a number of episodes in which social or personal beliefs distorted the work of researches." The eugeny is an example of this: "were used the techniques of science to try to demonstrate the inferiority of certain races."

"Despite such cautionary episodes it is clear that values cannot and should not be separated from science." "religious convictions about the nature of the universe have also lead to important scientific insights, as in the case of Lyell- who championed the idea that geological change occurs incrementally rather than catastrophically."

The empirical link between scientific knowledge and the physical, biological and social world sometimes can constrains the influence of values in science.

We can't forget that the scientist is also a common person, a citizen, a member of the society. The challenge for individual scientists is to acknowledge and try to understand the suppositions and beliefs that can be informed by study in many areas outside of science (history, philosophy, sociology, religion and ethics (Lezemore, Tor, 2002).

Example: The case of polywater (3). (Appendix 1).

- **Misconduct in science/honesty/ carefulness**

  Scientists should not fabricate, falsify, or misrepresent data or results. They should be objective, unbiased and truthful in all aspects of the research process.(2).

  This principle is science's most important rule. If this principle is not followed, it will be impossible to achieve science's goals. Neither the search of knowledge nor the solution of practical problems can go forward (David Resnik, 1998).

  Honesty also promotes the cooperation and trust necessary for scientific research it is justified on moral grounds: all people, including scientists, should be truthful.

  Beyond honest errors and errors caused through negligence are a third category of errors: those that involve deception. Making up data or results (fabrication), changing data or results (falsification) and using the ideas or words of another person without giving appropriate credit (plagiarism)- all strike at the heart of the values on which science is based (David Resnik, 1998) Many kinds of dishonesty in science involve the production and analysis of data.

Fabricating data is unethical in science because it is a form of lying, which is morally wrong. (David Resnik, 1998)

Scientists should avoid errors in research, particularly in the part of the presenting results. Experimental, methodological and human errors should be minimized and the phenomenon of self-deception, bias and conflicts of interest avoided.

Its easy to understand why most scientists view fabrication and falsification as serious violations of scientific ethics. Although, there is some disagreement about the

seriousness of misrepresentation because the “line between misrepresentation of data and good methodology is sometimes ambiguous” (Sergestrale, 1990 in (2)).

The most common forms of misrepresentation are known as trimming, cooking and fudging (Babage, 1970 in (2)). Trimming occurs when scientists fail to report results that do not support their hypotheses. Fudging occurs when scientists try to make results appear to be better than they really are. Scientists “cook” the data when they design tests or experiments in order to obtain results they already have good reasons to suspect will be positive or when they avoid conducting tests that are likely to yield negative results (David Resnik, 1998).

A lack of carefulness is not the same thing as dishonesty, since carelessness need to involve the intent to deceive (David Resnik, 1998). When relying is someone else’s work, scientists normally assume that the research is valid. It would be an incredible waste of time for them to check every piece of research one uses for errors. When errors plague the research process, cannot make this important assumption, they cannot trust each other, and must waste time and energy checking for errors

● **Conflicts of interest**

Sometimes values conflict, for example a researcher with stock in a company were paid to determine the usefulness of a new device produced by the company. Maybe this researcher can have a financial interest in this study.

Virtually all institutions that conduct research now have policies and procedures for managing conflicts of interest. Disclosure of conflicts of interest subjects these concerns to the same social mechanisms that are so effective elsewhere in society.

- Publication and openness

Science is not an individual experience. For that reason, the social conventions of science play an important role in establishing the reliability of scientific knowledge. After publication, scientists expect that data and other material will be shared

The professional isolation can damage a scientists' work scientists cannot isolate themselves from society, they must be active in contribution to public policy and to the understanding of science by nonscientists.

Error and negligence in science

"Scientists can never prove conclusively that they have described some aspect of the natural or physical world with complete accuracy. In that sense all scientific results must be treated as susceptible error. Scientists do not have limitless working time or access to unlimited resources. Even the most responsible scientist can make an honest mistake. When such errors are discovered, they should be acknowledged, preferably in the same journal in which the mistaken information was published. Scientists who makes such acknowledgements promptly and openly are rarely condemned by colleagues, on the other hand those who don't do this, are placing their reputation, the work of their colleagues, and the public's confidence in science at risk…."

One of the most difficult situations that a researcher can encounter is to see or suspect that a colleague has violated the ethical standards of the research community. It is easy to find excuses to do nothing, but someone who has witnessed misconduct has an unmistakable obligation to act. At the most immediate level, misconduct can seriously obstruct or damage one's own research or the research of colleagues. More broadly, even a single case of misconduct can malign scientists and their institutions, result in the imposition of counterproductive regulations, and shake public confidence in the integrity of science.

An important consideration is deciding when to put a complaint in writing. Once in writing, universities are obligated to deal with a complaint in a more formal manner than if it is made verbally. Putting a complaint in writing can have serious consequences for the career of a scientist and should be undertaken only after thorough consideration.

All parts of the research system have a responsibility to recognize and respond to these pressures. Institutions must review their own policies, foster awareness of research ethics, and ensure that

researchers are aware of the policies that are in place. And researchers should constantly be aware of the extent to which ethically based decisions will influence their success as scientists.(3)

Some final considerations **:**

The scientist in society

“Scientist's norms (principally honesty, objectivity, tolerance, doubt of certitude, and unselfish engagement) are in danger of serious distortion unless broadened to apply to the relations between scientists and nonscientists. Also needing supplementation is an ethic of development appropriate to a fast-changing society and advanced as an approach to the more effective and humane regulation of cultural and technological development. Because of their genetic relationships the code of the scientist and the ethic of development are probably complementary and together may overcome the shortcomings of each taken separately. Taken together, furthermore, they indicate the possibility of a humane world order based on the cooperation of a community of scientists and its public.” (A. Cournand, 1977)

Scientists should practice social responsibility in order to satisfy moral obligations and to secure the publics’ support for science

In our opinion there is an important question that must be made: Why ca not the scientist publish his results, even when he didn’t found what is was looking for? When he didn’t obtain the results that he could be expecting? All science society must give importance to the fact that “even a negative result is also a result!” If these fact was respected we think that a huge part of the papers that are published wouldn’t be the same, equal of those that were published in journals.

There is a web site called “Journal of negative results” that has all papers that were not published in important and scientific journals, but they are important too, as much as the others, so that scientists avoid the same errors, for example, to learn with those who didn’t get the answers of their hypotheses and initial objectives.

Group report- What is nowadays allowing bad science to still exist?

- Scientists will not access the ethical rules until they will feel the curiosity to look for them
- Scientists forge results for personal comfort reasons (happiness)
- Since a negative result is a scientific result, it's minor acceptance may lead researchers to avoid them. The alteration of this situation could make practiced science more innovative and ethical.
- Money interests can make scientists to bias results towards an interest (tobacco companies, etc.)
- Scientist abdicate on a more complete work to have more time to their selves
- Lacking conditions makes people more unmotivated and less productive
- Nowadays scientists still see what they try to understand through their societies' eyes

2. Ethical problems concerning GMOs

Definition

A genetically modified organism (GMO) is an organism whose genetic material has been altered using techniques in genetics generally known as recombinant DNA technology (Appendix N). Recombinant DNA technology is the ability to combine DNA molecules from different sources into one molecule in a test tube.

GMOs are divided in three groups: genetically modified microorganisms (GMM), genetically modified plants (GMP) and genetically modified animals (GMA). According to the damage they could cause to humans and environment, there are different subgroups. For example, GMP are represented by class 1 – GMP that have limited possibilities of genetic transfer to local crops or that are not a viable strain. Class 2 includes GMPs that easily transfer genetic material, are potential pests, are viable strain or whose genetic transfer can result in negative consequences. (2)

Benefits	Controversies
Crops: 1)Enhanced taste and quality; 2)Reduced maturation time; 3)Increased nutrients, yields, and stress tolerance 4) Improved resistance to disease, pests, and herbicides 5) New products and growing techniques	**Safety** 1) Potential human health impact: allergens, transfer of antibiotic resistance markers, unknown effects Potential environmental impact: unintended transfer of transgenes through cross-pollination, unknown effects on other organisms (e.g., soil microbes), and loss of flora and fauna biodiversity
Animals 1) Increased resistance, productivity, hardiness, and feed efficiency 2) Better yields of meat, eggs, and milk 3) Improved animal health and diagnostic methods	**Access and Intellectual Property** 1) Domination of world food production by a few companies 2) Increasing dependence on Industralized nations by developing countries 3) Biopiracy—foreign exploitation of natural resources
Environment 1) “Friendly” bioherbicides and bioinsecticides 2) Conservation of soil, water, and energy 3) Bioprocessing for forestry products 4) Better natural waste management 5) More efficient processing	**Ethics** 1) Violation of natural organisms’ intrinsic values 2) Tampering with nature by mixing genes among species 3) Objections to consuming animal genes in plants and vice versa 4) Stress for animal

Society 1) Increased food security for growing populations	**Labeling** 1) Not mandatory in some countries (e.g., United States) 2) Mixing GM crops with non-GM confounds labeling attempts
	Society 1) New advances may be skewed to interests of rich countries

Table 1. GM Products: Benefits and Controversies

Ethical problems

- *Concerning GMPs*

According to Darwinism, the human species is an animal species that have some responsibilities towards the environment. Most people consider GMOs dangerous for the biodiversity. In fact, there's not any prove that the production of GMOs is leading to a biodiversity's decrease. It's more reasonable to consider that genetically modified organisms are made for the opposite purpose: to increase the biodiversity. One good reason to do it is that GMOs can be used as a mean to enrich the genetic pool. The vegetables we are eating now are the result of an artificial selection as it was man who decided which are the properties we have to preserve and which are the qualities we don't need. As we know, bean and tomatoes are a good example of this fact. And even if someone argues that these products are a result of the selection, not a genetic modification, let us remind you the case with the tomatoes, called "Flavor and Savor". There aren't reported any negative consequences after eating these vegetables, so what is the difference with the other cultures? People fear that the development of new sorts of plants or animals will be the reason for the natural species to disappear. Although, GMOs are not produced to replace one species, but to assure that it won't disappear as a result of the growing necessities of the humanity. It's the question of the responsibility that counts.

Producing GMOs is one of the possible ways to help nature survive, because that is the main goal of science – to assure ours and other species' future. And why don't we start to introduce GMOs now? It's certain that in few years we will face the global starvation. This is why we have to start with the field experiments now, so that we could see if it is going to work in the future. There is a notion that since we cannot fully know the future we shouldn't worry about its shape and form. But why shouldn't our concern for the common good of all humanity include future generations of our species? Just because we can't control the future does not mean that we should not try to minimize harm and maximize good for our progeny. This is the so called "*principe de précaution*". We consider that everything we invent nowadays is done to ensure a better life for the future generations. The real problem is that man can't prevent all the consequences of his actions. According to this, isn't it better to start experiment now, so that we could see if the GMOs are the solution we are looking for? If they prove to have a negative impact, we will still have the chance to start searching for another way to resolve the coming problems. And if they happen to be useful, as we expect them to be, we will know that we have helped our children to face the future.

On the other hand, it is dangerous to do investigations with the transgenic organisms outside the laboratory. There is always a fear that interbreeding of genes can occur. In transferring a gene from one species to another we may also be transferring disease vulnerability, antibiotic resistance, cancer and a host of problems we are not yet aware of. Do we have the right to put endanger other species; this is the question everybody wonders about. We are not sure that that our fears will become reality, but we don't argue that this could happen. So, can we say that as the intention was good, one can't be blamed for the consequences? And can someone really predict what is about to happen? The essential in that case is to do all our best to improve the quality of our production so that it would have the minimal side effects, as long as we can predict them. That is also the reason new lows are made. Isn't science the tool for improving our and our children's life conditions? If we can't find a cure for a disease with the transgenic organisms today, does it mean that we have to give up trying? The science is the way to express our curiosity, the one that's created exactly because no one can know what would be the exact result of his actions. Regarding the genetics and its achievements, we

consider it as created to give us the solutions for problems that can't be resolved otherwise.

One of the major problems nowadays is to preserve the biodiversity. The majority of people accept that using GMOs to preserve crops is much better than using pesticides. We agree that if this idea comes to practice we will decrease the ecological damages, such as poisoning of the air, poisoning and destroy the soil. Although, both methods are very invasive, so we should think about a solution, that won't have negative effect in the future.

The first thing to do is not to try to increase biodiversity, but to preserve the one we are having now. As a demographic crisis is about to come, the humanity is looking for a way to assure enough agro – ecosystems to meet future needs. In fact, there is a very simple decision of that problem that doesn't require new areas to be cultivated. There are countries producing much more that they could actually use and others, that don't have the environmental conditions to raise the same crops. The European Union already made a step with imposing the quotas. But as we regard ourselves as a global society, we need a global market too. Like that, all the production will be completely used, without wasting it, and maybe it is the first thing that will show us the right why to go in preserving biodiversity.

- *Concerning GMAs*

According to Peter Singer's theory, animals are equal to humans as they have the ability to feel pain and pleasure. They suffer just as humans do. Some people think that they also have dignity. Is it really so? What is this dignity? Some believe that human dignity is based upon your abilities. For Peter Singer, the value is based on the ability to plan and anticipate your own future. As he says, infant children have less innate value or dignity than monkeys, since monkeys have a greater awareness of and ability to impact their surroundings than infants do. This means that it may be moral for parents to kill their disabled infant. This narrow view of human dignity means that some slice of humanity is not subject to the protections the rest of humanity enjoys.

For others, human dignity is innate and comes from God. For example, Christians, Jews, and Muslims believe that God is the creator of humanity and that our innate value

comes from the value God places on us. As God has placed his image on each one of us, we bear a special and unique value that no other human has the right or freedom to manipulate or destroy. This broad view of human dignity covers all of humanity. For most, it covers humanity from creation to natural death. In many ways, we should treat others in the manner of Christ's words, "Do unto others as you would have them do unto you."But is it possible to do that as we consider ourselfs to be the most superior of all living creatures?

A recent collection of essays in favor of Christian physicalism is entitled "From Cells to Souls", illustrating the pervasive assumption that "soul" arises from "cells." Functionalists examine psychological and neurological processes in terms of the functions or behaviors performed by the organism; monists are those who teach there is only "one substance" in the world.

An ancient religion, the animism considers that everything in nature (animals, plants, minerals etc) is animated. Hinduism also perceives all components of universe having a divine nature. Having in mind all these beliefs, can we say that animals have the same rights as people do? Although, having rights one is supposed to have duties too. In this meaning animals do not have rights; but they have the right to be protected from inadequate violence implied by people. For example, in United States an "Animal Police" has been fondated to guarantee an appropriate behavior towards domestic animals.

At the same time scientists are creating life in tubes. We have the transgenic animals, created not only for scientific purposes, but often only for pleasure. The problem with GMAs is that we never know what the result would be. Do we have the right to create animals whose life is fully dependant on our knowledge and skills even when we are not aware of our abilities? The Dolly sheep was created by using the clone technologies, but the DNA used was taken from somatic cells (having shorter telomere sequencies). This led to a much shorter life of the clone that was expected according to the natural one. The technological development resolve this problem and it doesn't exist anymore, but can we guarantee that problems like this won't happen again in the futur? Another problem to think about is whether animals have rights as they don't have duties. Can we consider clones as objects only because they are not created on the conventional way, as they are not the result of natural reproduction?

The first transgenic animals were much bigger than their “brothers”. Does it mean that they were some kind of monsters and that it’s the way the future transgenic animals will look like? But it often occurs that animals produced by selection breeding are as much “monsters” as the GMAs are. We do not find it acceptable to stop scientific progress only because we are not fully aware of the result. The aim of the scientists is actually to experiment, make mistakes, to fix and use them so that he can move ahead.

- *Ethics of discussion*

People are used to blame scientists on playing God. Especially geneticists, who are experimenting with the substance of life, and the ultimate price could be life itself.

Is the scientist the new Prometheus, or science is revealing the one thing left in Pandora’s Box? That’s the question that troubles us all. We are living in the technoscience century. During our lifetimes, we have become accustomed to a spiraling array of great technological advances. These advances have helped us live longer, made our lives more comfortable, and brought us unparalleled prosperity. But every new technology is a double-edged sword.

In one person there is the cool-headed, “objective” scientist and the moral, believing animal. [ii] To be a whole person these aspects must be integrated. Just as scientists should not expect the public to discuss moral and religious beliefs in the face of the scientific discovery ”du jour”, so the public should not require scientists to divest themselves of their moral and religious beliefs. And, whether they like it or not, or acknowledge it or not, every scientist has moral and religious beliefs of some sort - because, at least in part, that’s what it means to be human. It is important to emphasize on the fact that science itself don’t have moral. The moral is a part of the scientist, as he is first of all a human being. It is inevitable the existance of researchers who have no morality at all. That doesn’t mean that science itself is not ethical. There is a need of understanding so the right way to achieve this is the argumentated discussion. Instead of simply increasing public understanding of science, scientists need to have a real dialogue with members of the public, listening to their concerns, their priorities, and the questions they would like us to help answer. We also need to find ways to move science forward while adapting to their legitimate concerns.[i]

Many scientists argue that the solution to the tension between science and society is to increase public understanding of science. The truth is that the problem is not simply a lack of comprehension. People are against the fundamental nature of the methodes we use in our work as scientists, and they don't like it. More education would not be enough. In fact information is the basis for education. (Appendix 3) Scientific research must not be done in the shadows. Science must be done in full view and in conversation with the citizens who fund most of the science in all countries, whether through tax funding or through consumer spending. Credible scientists never contradict or go beyond the available data. We should never insert our personal values into discussions with the public about scientific issues. On the other hand, it is important to recognize that the rest of society is not constrained in that way and can mix facts and values at will. But the information that comes from society is also very important. Even if not scientific, it shows us the problems that have to be resolved. No matter what a scientist believes about moral issues, if an opponent in a debate introduces values or beliefs, the scientist should disclaim any ability to comment on those issues outside the scientific realm. Likewise, ethics cannot be done without understanding science. Only in combination of the two can genuinely ethical decisions be made.

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