Opinions On And Attitudes Towards Genetic Engineering: Acceptable Limits
A: The Discussion Task

Young People's Understanding
Of, And Attitudes To, 'The New
Genetics
Working Paper 7

Contents

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Abstract

In this paper, we report findings on students' opinions about genetic engineering and the criteria which they might use in coming to these opinions, as elicited through group discussions following the presentation of stimulus material. The rationale, design and methodology of this approach to probing attitudes and opinions is presented. Many students in the 15-16 age range seemed able to form justified opinions about genetic engineering. In cases where the opinions formed by students were not justified, the limiting factor on performance tended to be in terms of the students' argument skills rather than their knowledge of genetics. The implications of these findings for teaching about areas of genetics with a strong attitudinal component are discussed, as are links between school genetics teaching and the broader concept of 'genetic literacy'.

1 Introduction

This paper reports on a study of young people's opinions on, and attitudes towards, genetic engineering (recombinant DNA technology).

DNA technology is developing at a rapid pace. DNA data bases have been set up, DNA fingerprinting is a routine forensic tool, screening for genetic disease is becoming commonplace and genetically modified food is now on sale. Each of these uses of DNA technology raises important social and ethical issues, for the individual as well as for society. Part of the rationale of this project was to investigate the ways in which young people nearing the end of their compulsory science education interact with information about 'the new genetics' and identify, evaluate and form opinions on issues that arise (see Wood-Robinson *et al*, 1996). In recent years, arguments have been put forward for teaching science as part of the compulsory curriculum for all young people in order to promote 'scientific literacy' or 'the public understanding of science' (e.g. AAAS, 1989; Office for Science and Technology, 1993; The European Commission, 1995). Three main reasons tend to be put forward for promoting the scientific literacy of all students, including those who will not study science beyond the age of compulsory schooling:

- the utilitarian case: knowledge from school science will be practically useful in personal or professional contexts in later life;

- the democratic case: in order to participate in democratic decision-making on issues with science content, a minimum level of scientific understanding is required; and
- the cultural case: science is a major cultural product and should therefore be studied as part of a general education.

In practice there are limits to the extent to which school science can prepare people to use science, either in a utilitarian or a democratic way, in their adult life. It is not realistic to expect the school science curriculum to cover in detail all the scientific fields likely to be encountered by all future citizens in their personal and professional lives (Layton *et al*, 1993). In addition we know very little about the ways in which people actually draw upon and use various forms of knowledge in problematic contexts with a science dimension (Layton *et al*, 1993; Irwin, 1995). A more realistic aim for the school science curriculum might be to equip all young people with a basic range of scientific knowledge, together with some understanding of the sorts of situations in which such knowledge might be useful. The issue then becomes - what basic knowledge might students need and how best to prepare them for situations in which they might need to use such knowledge?

In this study students nearing the end of Key Stage 4 were presented with basic information about genetic engineering, together with some indication of the sort of issues which different uses of genetic engineering might give rise to. They were then asked to discuss, in small groups, a number of specific uses of genetic engineering and come to a reasoned view on the acceptable uses of genetic engineering. When discussion was complete each group was interviewed in order to probe the consistency of, and the justification for, the views expressed within the group. Transcripts of these discussions and interviews form the data for this study. Analysis of the data focuses on the ways in which these young people interacted with the information about genetic engineering and identified, evaluated and formed opinions on the issues that arise from various applications of genetic engineering. It also identifies the criteria which students appeared to be using when deciding which applications of genetic engineering are socially acceptable and which are not, and the actual views which they came to. In total, 62 students aged 15-16 took part in this study, working in 15 groups.

This study was part of a much larger research project on '*Young People's Understanding of, and Attitudes to, The New Genetics*'. The overall aim of this project was to produce baseline data on the understanding of genetics, awareness of DNA technology and attitudes towards DNA technology of young people nearing the end of their compulsory science education. All students taking part in this project had followed the 1991 National Curriculum (DES,1991).

The project as a whole was based on four main research questions :-

1. What knowledge and understanding of genetics do young people have at the end of their compulsory science education?

2. What knowledge and understanding of new gene technologies do these same young people have?
3. What issues do they perceive as being raised by the application of new gene technologies in particular contexts?
4. What opinions and attitudes do these young people form concerning the application of these technologies?

The work reported in this paper relates to research questions 3 and 4. These questions were also investigated through a written survey of 444 young people and through the use of a second audio taped discussion task which focused on pre-natal screening for cystic fibrosis (Leach *et al*, 1996).
Research questions 1 and 2, relating to knowledge and understanding of genetics and gene technology, were investigated through a written survey of almost 500 young people (Lewis *et al*, 1997; Lewis *et al*, in preparation) and through a series of audio taped group discussions involving 36 young people. In total, more than 700 young people aged 14 - 16 took part in the project.

2 Design, methodology and administration of the genetic engineering discussion task

2.1 Rationale and design of the task

This probe was designed to:-

- identify the views and opinions which students expressed when considering a specific application of genetic engineering and
- identify the criteria which students focused on in deciding whether or not different applications of genetic engineering were socially acceptable.

In order to do this it was necessary to:-

- present students with information about the technique of genetic engineering and check their understanding of that information;
- present students with information about a number of different applications of genetic engineering;
- present students with various points of view about different applications of genetic engineering and
- give students the opportunity to discuss their own views, both with peers and with an interviewer.

Within this project the term 'issue' is used to mean any matter arising from a particular context which potentially involves a decision being made. The term 'opinion' is used to mean a value position relating to particular issues within specific contexts and the term 'attitude' is used to refer to value positions which are more general. For example, the option of aborting an affected foetus is one of the issues which may arise when considering prenatal screening for cystic fibrosis. After considering this issue, some people might express the view that abortion of a foetus because it had cystic fibrosis was unacceptable. We would consider this to be an opinion. Others might express the belief that abortion is ethically wrong under any circumstances. We would consider this to be an attitude.

Although the formation of opinions and attitudes is presented as a free-standing research question, separate from the identification of issues, such a separation is largely artificial. The inability to perceive some of the key issues, for whatever reason, is likely to reduce the ability of an individual to reach an informed opinion. For example, in considering the genetic screening of individuals for Huntington disease some students made the naive assumption that all those who had access to the results of screening would assist an affected individual. As a result, many of these students expressed the view that employers had the right to know the results in order to provide support - completely ignoring the possibility that potential employers might not employ an affected individual in the first place. In effect, their ability to recognise the issues was limited by their limited experience of life. In the following example, students' inability to recognise the issues was limited by their understanding of the science. In considering somatic and germ line gene therapy many students were unaware of the genetic and biological differences

between somatic and germ cells and as a result were unaware that the issues might be quite different. As a consequence such students expressed similar opinions in both cases, and gave similar justifications.

Just as opinions are in part determined by the issues which are considered, so issues are dependent on the context. When considering gene technology the actual technique to be used, the purpose it is to be used for, the type of organisms to be used and the type of cell involved will all influence the issues that are likely to be identified and the opinions which are likely to be expressed. For this reason, attempts to probe opinions without specifying the exact context are unlikely to yield useful information. This view of the inter-relationship between context, issues, opinions and attitudes underpinned our approach to the study of young people's attitudes to the 'new genetics'.

In designing a research instrument which would probe students' views on genetic engineering we assumed that if students were to come to an informed opinion they would need to understand the specific contexts which they were being asked about. They would also need to have some awareness of the key issues which these contexts might raise and the criteria which might need to be considered in coming to a view. We also assumed that students would need an opportunity to articulate their own views and to discuss opposing arguments in order to clarify their own thinking and come to a reasoned view which they could justify (Barnes and Todd, 1977). In providing opportunities for discussion we would gain access to students' thinking about genetic engineering.

Preliminary research suggested that most students aged 15 - 16 would have only limited knowledge of genetic engineering, despite its inclusion in the National Curriculum. The KS4 Programme of Study states that pupils:-

> *'should have the opportunity to consider the basic principles of genetic engineering, for example in relation to drug and hormone production.'*
>
> (DES1991)

In addition, students found it difficult, especially within a limited time and working with an unfamiliar context, to identify relevant issues. Under such circumstances the opinions which they expressed were generally superficial and uninformed. Preliminary research also suggested that students would have a very limited understanding of basic genetic concepts. This was confirmed by findings from another part of the project (Lewis *et al*, 1997). In order to investigate students' opinions and attitudes to different applications of genetic engineering we therefore had to provide them with information - about the key genetic concepts, about the basic technique, about some specific applications of the technique and about some of the issues which such uses might give rise to. We also had to provide some focus for discussion.

Information about genetic engineering was provided in the form of a video. The genetic concepts on which the technique is based, and a simplified

account of the actual technique, were explained. The key points presented in the video are shown in Table 2.1. The full script can be seen in Appendix 1.

Table 2.1 - Key points presented in the video

A. Basic genetics	
1	Identification of the key structures:- *living thing, cell, nucleus, chromosome, DNA, DNA sub-units.*
2	The relationship between these structures.
3	The relative scale of these structures (macroscopic/microscopic/ submicroscopic).
4	Sub-units within the DNA produce coded messages which tell the cell how to make things; it is the *sequence* of sub-units which determine the message; the messages are separated into genes.
5	The code which is used is called the genetic code; the same code is used by all cells in all living things; for example, the message in a gene from a cell from a dog could be could be read and understood by a cell from a plant.
B. Genetic engineering	
1	The implications of a universal genetic code:- *if a gene from a dog cell is put into a plant cell the plant cell can make the dog gene product.*
2	The basic process of genetic engineering illustrated through the example of the blue rose:- *identify the gene for blue pigment in the cells from a blue flowering plant, cut it out, copy it and 'paste' it into cells from a rose plant; grow a new blue rose.*
3	Collection of cells for use in this process is painless, both for plants and animals. (The size of individual cells in relation to the whole organism is emphasised).
4	The difference between cross breeding and genetic engineering is noted (if **no** roses contain any genes for blue pigment then no amount of cross breeding will produce one).

Students' understanding of genetic engineering was then probed through a card sort activity. Each group of students was presented with 5 statements about genetic engineering on cards. The group was instructed to sort the cards into statements which they agreed with, statements which they disagreed with, and statements which they were not sure about. When the group had completed this activity an interviewer joined them to discuss their responses and to correct any misunderstandings. The card sort statements are shown in Table 2.2.

Information relating to statements 1, 2, 4 and 5 had been presented in the video. Information relating to statement 3 had not. This statement was included as it was felt that this knowledge - that a transgenic animal containing a human gene would carry that human gene in every cell in its

body - might influence people's attitudes towards the production of transgenic animals containing human genes. By including this statement we provided an opportunity for interviewers to discuss this concept with their group, so that all students were made aware of it.

Table 2.2 - Statements Used On The Card Sort Activity

1	'When genes are taken out of animals it is very painful for them' *False* *Designed to probe student understanding of size and scale and of techniques for obtaining genes.*
2	'The genetic code in plants works in quite a different way to the genetic code in animals' *False* *Designed to probe students' awareness of the universal nature of the code.*
3	'Sheep that produce human insulin have a copy of the human insulin gene in every cell in their body' *Potentially True* *(it would depend when the human insulin gene was inserted into the embryo)* *Designed to probe students' understanding that a 'foreign' gene would be found in most cells in the animals body, not just the cells producing human insulin.*
4	'Genes are so small that you need special laboratory techniques to separate different genes' *True* *Designed to probe students' understanding of scale.*
5	'Many hundreds of genes can be coded for in just one strand of DNA' *True* *Designed to probe students' understanding of scale and organisation - the relationship between genes and DNA.*

As noted earlier, factors which might reasonably be considered in forming an opinion are determined in part by the issues which are considered and these, in turn, will depend on the specific context. Genetic engineering is a general technique which can be applied in a number of different ways or contexts. For this reason most people would find it difficult to express an opinion about 'genetic engineering'. If asked, their most likely response would be '*it depends ....*'. The different factors on which it might depend would reflect the criteria which might used in coming to a reasoned view about a particular use of genetic engineering. For example, two factors on which an opinion might depend are *the types of organism involved* and *the purpose for which the technique is being used.* The criteria being used in this case might be *the relative importance of different organisms* and *the acceptability of the purpose.*

Table 2.3 - Summary of main features

	key factors	
application	**gene transfer**	**potential uses**
1. Human Growth Hormone	human to sheep human to bacteria	medical; treatment social; enhancement/advantage
2. Gene Therapy	human to human	medical; treatment (somatic) medical/social; 'cure' (germ) social; selection (either)
3. The Oncomouse	mouse to mouse	medical; research
4. Scorpion Venom Pesticide	scorpion to virus	commercial; agricultural
5. High Yield Crops	plant species (a) to plant species (b)	commercial; agricultural

In order to identify the criteria which students used in coming to a view about genetic engineering we therefore needed to provide them with a number of different contexts. Five different uses of genetic engineering were chosen as examples - *Human Growth Hormone, Gene Therapy, The Oncomouse, Scorpion Venom Pesticide* and *High Yield Crops.* These were selected to include a range of types of organism (human, other vertebrates, invertebrates, plants, bacteria and viruses), to cover a range of different uses and to raise as many different issues as possible. A summary of these features can be found in Table 2.3. A more detailed analysis can be found in Appendix 2.

Figure 2.1 - Context Card For Gene Therapy

Gene Therapy

* In humans, some illnesses e.g. Cystic Fibrosis, are caused by genes which don't work properly.

* If the faulty gene could be replaced by working copies of the gene, the illness could be cured. This is called gene therapy.

* But the disease could still be passed on to any children. Only by altering the eggs and sperm can the disease be got rid of completely.

* If it were possible to alter the genes in eggs or sperm for medical reasons it might also be possible to alter other genes for other reasons.

* At the moment, scientists are not allowed to change the genes in human eggs or sperm.

" Gene Therapy seems like a good idea. I think it's time they started work on eggs and sperm."

" Gene Therapy should never be used, not even to cure illnesses "

Students were provided with information about each of these contexts on a set of cards - one card for each context. On the right hand side of each card the particular use of genetic engineering was described and key points noted. On the left hand side of the card two different points of view about that particular use of genetic engineering were given. The purpose of these was to provide a focal point for discussion. An example of these cards can be seen in Figure 2.1. The set of cards can be seen in Appendix 3 (a - c).

A number of issues which these, and other, uses of genetic engineering might give rise to were presented in the form of a short audiotaped drama, featuring two 6th form students discussing the university course which they intend to apply for (business studies for one, genetics for the other). The complete text of the audio tape can be seen in Appendix 4. The different viewpoints presented on the cards and in the drama are shown in Table 2.4. They provided students with possible starting points for their own discussions and highlighted some of the criteria which might be used in evaluating a particular application of genetic engineering.

The following facts, which might influence a person's attitude towards some aspects of genetic engineering, were also included in the video and/or audio tape:-

- the focus of modern genetic experiments is on cells rather than whole organisms;
- genetic engineering need not hurt animals or plants; it can be done using cells, which can be collected painlessly - even from humans;
- Human Growth Hormone can be used to gain social advantage as well as for medical benefits;
- viruses are host specific and can't live independently and
- it's possible to patent genes.

Three views about patenting were expressed:-

- I don't think it's right to patent genes;
- firms must patent genes to protect their investment and
- this type of research should be used for the good of everyone, not the profit of a few.

Once this information had been presented to the students they were asked to discuss each context before coming to a view. This gave them an opportunity to articulate their views, to discuss opposing arguments, to clarify their own thinking and to come to a reasoned view which they could justify. Providing opportunities for discussion also allowed us to access students' thinking about genetic engineering.

The design of this discussion task was based on preliminary research with over 90 young people using open ended written questions and semi-structured interviews. Drawing on the findings from this preliminary work, pilot materials were produced which were trialled and modified in order to

produce the final version for use in the main study. The whole task was designed to be completed within one lesson of 70 - 80 minutes.

Table 2.4 - Views expressed on the audio tape and cards

Context	Views expressed	Location
Human Growth Hormone	• at least the sheep aren't released into the wild to breed • other organisms could be used - like bacteria... • so it's OK to mess with bacteria but not with animal? • It's OK if it's going to help people (medically) rather than make money for a few • but the person making the money might also be helping people • anything can be misused • some things are more OK than others	audiotape
	• I don't think that human genes should ever be put into animals or bacteria just so that some people can grow extra tall • I think that it's a good idea if affected children can grow normally	card
Gene Therapy	• that's got to be good • it's a bit like Nazi Germany, deciding what illnesses are acceptable and what are not • we might all end up the same • we're messing about with nature if we change genes that can be passed on to the next generation	audiotape
	• gene therapy seems like a good idea; I think it's time they started work on eggs and sperm • gene therapy should never be used, not even to cure illness	card
The Oncomouse	• sometimes it's necessary to work with whole animals rather than cells • poor mouse, doomed to die of cancer from the day it's born • do you *know* how many people die of cancer every year?	audiotape
	• it's OK to use animals in this way if it makes cancer treatment more effective and helps to save human lives • it can never be right to deliberately design an animal which is guaranteed to suffer	card
Scorpion Venom Pesticide	• better (than chemical pesticides) for the environment • it will put manufacturers (of chemical pesticides) out of business • it might contaminate our food • it would not contaminate our food • it's wrong to tamper with genes and then release them into the environment; it might have unexpected consequences • this is messing with the balance of the ecosystem • it would increase crop yields and help to feed the world • someone must be making lots of money out of it	audiotape
	• I don't like this idea at all • if it protects the crops it's a good idea	card
High Yield Crops	• moving genes about between different living things can never be right • there's nothing wrong with moving genes about between different plants	card

2.2 Administration of the discussion task

The task was administered to one whole class of students at a time. Students worked in self selected groups of 4 or 5 and each group was assigned an interviewer.

Before any group work began, students were given an introduction to the whole task and shown the video. Students then returned to their groups, where their interviewer introduced the cardsort activity. The interviewer then withdrew, but continued to observe the group's progress and listened for specific points to which they might want to return later. Once the group had finished the cardsort activity, the interviewer returned and discussed the students' decisions and justifications, correcting any misunderstandings as necessary.

The audiotaped drama was then played to the whole class. Afterwards students returned to their groups and the group interviewer introduced the main activity. Each student was given a set of numbered cards which they were asked to read. This was to ensure that as many issues as possible had been raised, through the different contexts, before the students started to discuss their own views. When this had been done, the group was asked to consider each context in turn, reading the text out loud (to ensure that all members of the group had the same information) and discuss the two points of view which were presented. The group were then asked to consider their own point of view about that particular use of genetic engineering before going on to the next card. The interviewer withdrew during this part of the activity but again continued to observe the group's progress and listened for specific points to which they might want to return.

When the activity was completed, or the time limit had been reached, the interviewer returned to the group and discussed the students' responses to each card. In particular, the interviewers were asked to probe :-

- the extent to which students thought that there should be limits to the use of genetic engineering;
- what those limits might be and
- what determined those limits.

They were also asked to ensure that the group had distinguished between somatic and germ line gene therapy and to probe the groups' views about each. Interview schedules can be found in Appendix 5a-c.

All discussions, with or without the interviewer, were audio taped and later transcribed.

All interviewers, including members of the project team, attended a training session prior to data collection.

The methodology used in this study, collecting data through transcribed audiotapes of small group discussions, contrasts with the study by Lock and

Miles (1993) which was based on individually completed questionnaires and made use of attitude statements and Lickert scales.

2.3 Sampling

The sample for this probe was a subset of the main sample and was drawn from three different schools - one complete class from each school. Selection of these classes was in part opportunistic. While it is not possible to claim that this small sample is statistically representative of the sample as a whole, classes were selected to cover the age and ability range as far as possible. Within each class, students worked in groups of 4 or 5 and each group had an interviewer. In total, 15 groups were interviewed, representing more than 60 students. Details of the sample can be found in Table 2.5.

School A (39% of the sample) had covered all the genetics in the curriculum, including genetic engineering. School B (19% of the sample) had covered as much of the genetics curriculum as it was likely to, including a little genetic engineering. School C (42% of the sample) had just begun genetics and had covered inheritance but not genetic engineering.

Table 2.5 - Details of the sample for the genetic engineering task

School	Characteristics of whole class	Group no.	Gender composition of small groups
A	Upper ability range Year 11 (age 15-16)	1	4 Male
		2	4 Female
		3	4 Female
		4	2 Male 2 Female
		5	4 Female
		6	4 Male
		7	2 Male 3 Female
B	Lower ability range Year 11 (age 15-16)	4	2 Male 1 Female
		5	2 Male 2 Female
C	Middle ability range Year 11 (age 15-16)	1	3 Male 1 Female
		2	4 Male
		3	1 Male 4 Female
		4	4 Male 1 Female
		5	1 Male 4 Female
		6	4 Male
Totals		15	32 Male 30 Female (total = 62)

For the project as a whole 743 students, drawn from twelve co-educational comprehensive schools, took part. Most of the students (84%) were in their final year of compulsory schooling (aged 15-16). The remainder (16%) were in their penultimate year (aged 14-15). All the participating schools taught science in classes which were grouped by ability. In each school teachers

were asked to nominate one high ability class, one middling ability class and one class of low achievers to work with us. Viewed as a whole, our sample represented the full range of ability and achievement normally experienced in maintained secondary schools in West and North Yorkshire. 54% of the sample came from schools which stated that they had been taught all the basic genetics components of the National Curriculum (DES, 1991), with a further 11% having been taught some genetics. 39% of the sample were from schools which stated that they had been taught about genetic engineering.

2.4 Analysis of the genetic engineering discussion task

In this task we were looking at the use of genetic engineering across a range of contexts and considering how young people decide which uses are acceptable and which uses are not. It was therefore not possible to use issues as the focus for this analysis. Instead, the focus is on the criteria which students apply when considering the acceptability of genetic engineering in different contexts - the criteria they consider; their general views about those criteria, for example the type of organism which it is acceptable to use; and the relative importance of different criteria when reaching a view about a particular context, for example whether human benefit is more important than animal rights.

The transcribed audio tapes of group discussions and group interviews provided the data for analysis. From the transcripts it was not always possible to identify which individual was speaking. In addition, the view(s) of the group could not be attributed to particular individuals. For these reasons, analysis was carried out at the group level.

The analysis of the card sort activity was designed to provide fairly crude information about students' scientific understanding. In the first instance, the responses of each group to each statement were identified within the transcripts. Any background argumentation and reasoning used by students to explain their response was also identified, as were differences of opinion between individuals within the group. If interviewers added points, and group members responded to these, then those extracts of transcript were also identified. From amongst the identified sections of transcript, each groups' response was classified as agreeing with the statement, disagreeing or undecided. A note was made as to whether the interviewer corrected particular scientific points made by group members or not. Full details of this analysis are presented in Section 3.1 and Appendix 6.

To analyse the group discussions on genetic engineering, each transcript was read through with a view to identifying sections of the transcript where students' viewpoints and arguments were made explicit. As a first step, a summary of each transcript was made, which included all views expressed within the group, the issues which were focused on, the justifications which were given and the questions which were asked. In many cases, students did

not give explicit justifications for viewpoints. In other cases, it appeared that some issues were being used as criteria against which possible uses of genetic engineering might be judged. Sometimes, these criteria were used systematically, being applied to a number of different contexts. In other cases only specific issues, related to only one context, were considered. More information on this matter is presented in Section 3.2. If more general attitudes or beliefs were expressed, these were noted in a similar way.

Groups of similar criteria were generated, and treated as a coding scheme. Each transcript summary was coded according to the criteria mentioned in the group discussion, every point that was made being coded. Brief mentions of a criteria, and extended discussions about that criteria, were treated in the same way. The final views of each group, after discussion with the interviewer, were then summarised, together with the key criteria that appeared to have influenced this final view.

The coding scheme, and results of coding, can be found in Appendix 7a and Section 3.2 respectively.

3 Findings

3.1 Understanding the background science

A summary of group responses to the card sort activity can be found in Appendix 6 and details of responses to each statement are given in sections 3.1.1 - 3.1.5 below.

After watching the video most groups were aware that obtaining genes for use in genetic engineering need not be a painful process, that genes are very small and that many hundreds of genes can be coded for on one strand of DNA.

Within the groups, many disagreements were resolved by group discussion without the intervention of an interviewer - although the complexity of these discussions, and the firmness of the agreement, varied considerably.

Most of those groups who either did not know, or could not reach agreement on, how to respond to a statement came to a better understanding through discussion with their interviewer. One group were not able to do this because their interviewer (a substitute, brought in at short notice) misunderstood the purpose of the card sort activity and failed to correct any misunderstandings. However, over half the groups did not appear to distinguish between the message within the gene and the mechanism that allowed that message to be read. As a result, these groups did not appreciate that the genetic code could be the same in plants and animals. There seemed to be an intuitive resistance to the idea and a number of these groups could not accept it, even after discussion with their interviewer.

Information about the way in which recombinant ('hybrid') DNA would be distributed in the cells of transgenic animals was not presented in the video. Not surprisingly, only one group showed an understanding that most of the cells in a transgenic sheep would contain the gene for human insulin. The main reasons for *not* thinking this would be the case are given in section 3.1.3. In this case, all groups responded to discussion with their interviewer and came to appreciate why this would be so.

3.1.1 'When genes are taken out of animals it is very painful for them'

All groups disagreed with this statement, unanimously. However, three groups also expressed the view that it might depend on the circumstances or the methods used. One group, in discussion with the interviewer, also drew links between this statement and statement 3 (*'sheep that produce human insulin have a copy of the human insulin gene in every cell in their body'*). Having just been told, in discussion of statement 3, that all cells in your body contain genes, but only some of those genes are active in any one cell, the group suddenly realised the implication of collecting genes painlessly from the cheek cells - that these cells contain *all* the genes:

9.1 we should have got that one then because they're about the same, aren't they?

I ***Yeah, that's right, that's just the point because you can get all the information that you need.***

School C/Group2[1]

3.1.2 'The genetic code in plants works in quite a different way to the genetic code in animals'

There was widespread difficulty in recognising the universal nature of the genetic code. Only 7 groups recognised this as being a false statement and in 3 of these groups there was some discussion before the group came to this view.

The main source of this confusion seemed to be between the genome (the messages within the genes) and the genetic code (the language in which those messages are written). The combination of messages within the genes will be unique but the language in which those messages are written is universal. Several groups justified their response by referring to the differences between plants and animals:

24.1 plants and ..... animals.....they've got different like qualities and things like that

SchoolA/Group2

Many students seemed unable to recognise that there were two separate concepts involved here, even after discussion with their interviewer. A similar problem was identified in written responses to a survey question on the genetic code. A large number of responses described the genetic code as a sort of bar code, unique to each individual (see Lewis *et al*, 1997).

3.1.3 'Sheep that produce human insulin have a copy of the human insulin gene in every cell in their body'

There was widespread disbelief of this statement, for which no information had been included in the video (see Section 2.1). Three main reasons for *not* thinking this would be the case were identified. The first focused on the practicalities of getting a copy of the gene into every cell:

2.16 Every cell?
(...)
2.18 They ***can't*** *put it in* ***every*** *cell, they can't put it in every cell.*

SchoolA/Group4

These groups appeared not to appreciate that all genetic information is copied at cell division and that each new cell receives one complete copy of that information.

The second reason focused on the belief that cells only contain the genes which they need in order to function:

4.4 No, I'm sure it's not because like if you're human, then you don't have an insulin cell in all your cells do you? Cos there are just insulin cells, so like ....

[1] See note on format of the quotes at the end of this report

wouldn't have insulin cells in your brain cells would you?

SchoolA/Group3

Again, a similar problem had been identified from written responses in other parts of the project. The majority of students believed that the type of genetic information found in the cell was related to the function of the cell - cells of the same type contained the same genetic information, cells of different types contained different genetic information (Lewis *et al*, in preparation).

The third reason was the belief that if all the cells in a sheep contained that one human gene, the sheep would be human:

6.71 *If they have it in every cell they'd be human and they'd just be walking around talking like us.*

SchoolC/Group4

Again, similar views were expressed by some students in response to written questions about transgenic cows (Lewis *et al*, 1997).

A confusion about cells and the relationship between gene and cell, illustrated in the middle quote above, was evident in many of the discussions:

4.51 *No because they'd be like human sheep then wouldn't they?*

4.52 *Yeah, if they had human cells left in them*

SchoolC/Group2

Explanations by the interviewers, focusing on the introduction of the human gene at the embryo stage and the copying of genes prior to cell division and emphasising the consequences of this - that all subsequent cells would contain a copy of the human gene - appeared to be convincing. As some students assimilated these ideas they also suddenly understood why it was possible to collect any genes which were wanted from the cells found in a mouth wash - because all cells contain all the genes, not just some of them (see Section 3.1.1).

3.1.4 'Genes are so small that you need special laboratory techniques to separate different genes'

All groups agreed with this statement.

3.1.5 'Many hundreds of genes can be coded for in just one strand of DNA'

11 of the 15 groups agreed with this statement, but not always without some disagreement within the group. However, one of these groups appeared to have misunderstood the statement, believing it referred to *copying* the genes rather than coding the genes:

2.14 *They can can't they cos they do that with the police*

2.15 *Don't know, yeah it must be*

2.16 *They do don't they cos I mean like when they're investigating into crimes...*

2.17 *Yeah, they do*

2.18 They take like DNA samples

SchoolA/Group7

Most of the remaining groups agreed with the statement after discussion with their interviewer. The reasons why groups or individuals did not agree with this statement were not clearly articulated.

3.2 Views on the use of genetic engineering

3.2.1 Criteria used by the groups in coming to a view

Analysis of the transcripts showed that these students used a wide range of criteria when considering the extent to which a specific use of genetic engineering was acceptable. Within different contexts groups focused on different criteria but all groups, at some time during their discussions, considered the type of organisms involved, the effect on those organisms and the purpose for which the technique was being used (criteria 1a, 1e and 2a; see Appendix 7a). Most groups also considered the extent of the need for the product or technique, the effectiveness of the technique or the product, how safe the technique or the product was and the environmental and human consequences of using the technique or product (criteria 3a, 4a, 5a and 5c/d; see Appendix 7a). In addition, most groups also took personal beliefs and moral or ethical considerations into account. One third of the groups also explicitly acknowledged that their views would be influenced by personal considerations - that if they were personally affected then their views might change.

A description of the full range of criteria which the groups considered when discussing the different applications of genetic engineering can be seen in Appendix 7a and the use of these criteria by individual groups can be seen in Appendix 7b. The main criteria used by each group are summarised in Table 3.1.

The range of criteria considered by the groups and described in Appendix 7a included all the criteria explicitly considered in the audio drama or on the information cards. These criteria, and the number of groups which used each of them, are shown in Table 3.2. A comparison of the two tables (Table 3.1 and Table 3.2) show that the groups considered a number of additional criteria, in particular:

1c - similar or related uses of organisms which already occur (6 groups);
3b - possible alternatives (8 groups);
4a - the effectiveness of the technique or product (13 groups);
4b/5b - the extent of our knowledge regarding the effectiveness or safety of a technique or product (7 groups) and
6c - the feasibility of controlling the use of a technique or product once it was available (7 groups).

Table 3.1 - The main criteria considered by individual groups during discussion

criteria	A1	A2	A3	A4	A5	A6	A7	B1	B2	C1	C2	C3	C4	C5	C6	total
1. Relating to the organism																
a - type	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	15
b - origin			●	●					●				●			4
c - similar uses	●	●					●		●			●		●		6
e - effect on	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	15
2. Relating to use																
a - what purpose?	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	15
b - who's benefit?				●		●	●		●	●		●	●	●	●	9
3. Relating to need																
a - the need	●	●	●		●	●	●	●	●			●		●		10
b - alternatives	●	●	●	●	●		●					●		●		8
4. Relating to effectiveness																
a - does it work?	●	●	●		●	●	●	●	●	●	●		●	●	●	13
5. Risk assessment																
a - how safe is it?		●	●		●	●	●	●		●	●		●	●	●	11
b - do we know?						●	●					●	●	●	●	6
possible consequences:																
c - d combined	●	●	●	●	●	●	●	●		●		●	●	●	●	13
6. Control																
a - the need for	●	●	●			●	●	●			●			●		8
c - the feasibility of	●	●	●			●	●				●			●		7
7. Commercial aspects																
a - commercial profit	●	●						●		●				●		5
c - access		●		●	●					●					●	5
8. Costs/benefits																
b - benefit vs harm	●	●	●	●			●									5
9. Personal belief																
a - c combined	●	●	●		●	●	●		●		●		●	●	●	11
11. Morals/ethics																
a - b combined		●	●	●	●	●	●	●	●	●	●	●	●	●	●	14

Table 3.2 - The criteria explicitly raised in the information provided to students

criteria	location	group use
1a - the type of organism	card (ONCO) drama (x1, + summary)	15 groups
1d - the origin and direction of exchanged genes	card (HGH, HYC) drama (x1)	3 groups
1e - the effect on the organism	card (HGH, ONCO) drama (x3)	15 groups
2a - the use that will be made of it	card (HGH, GT, ONCO, SVP) drama (x1, + summary)	15 groups
2b - the beneficiaries	drama (x1)	9 groups
3a - the need	drama (x1)	10 groups
5a - safety/risk	drama (x2)	11 groups
5c - possible consequences (environmental)	drama (x2 + summary)	10 groups
5d - possible consequences (human/social)	drama (x1)	12 groups
6a - the need for controls	drama (x1)	8 groups
7a - commercial interests/profit	drama (x3 + summary)	5 groups
8b - costs/benefits (harm vs good)	drama (x3)	5 groups
9b - personal beliefs ('messing with nature')	drama (summary)	8 groups
11b - morals/ethics (rights)	drama (x2 + summary)	14 groups

Key: HGH - human growth hormone GT - gene therapy ONCO - the oncomouse
HYC - high yield crops SVP - scorpion venom pesticide

3.2.2 General attitudes and beliefs

During discussions the groups expressed a number of general attitudes or beliefs which cut across contexts:-

1. Things are as they are for a reason (so we shouldn't be trying to change them).
   [6 groups]
2. Messing with genes is wrong (acting god, messing with nature).
   [9 groups]
3. All organisms are not equal (in general bacteria and plants were considered less important than animals and animals were considered less important than humans; the relative importance of different animals was often disputed).
   [9 groups]
4. Animals should not be used/made to suffer for the benefit of humans.
   [5 groups]
5. It's only acceptable to use/change an organism/individual if it can give its consent (it's wrong to choose the genes for another organism/individual).
   [5 groups]

6. If scientists can do it they will do it (along similar lines; if it is available people will miss use it).
   [2 groups]
7. Children should be loved for what they are (link with perfection).
   [1 group]

Only those groups who explicitly stated the beliefs listed above, in fairly unambiguous language, have been counted here. Similar views were stated in rather different terms in many of the discussions. In particular there was a feeling that we can't all be perfect and shouldn't try to be (that we should be accepted for what we are):

21.30 Yeah, its sort of getting into the depth of where, where do you stop really. Two like prospective parents can say well I want my child to be like this.

21.31 Yeah you could like order a child, couldn't you?

21.32 I don't think that's quite right.

School A/Group 3

17.28 Everyone would just be walking round looking perfect and it wouldn't be right good.

School A/Group 6

Also, the belief that once something is possible there will always be someone who will do it, whatever the controls and restrictions:

29.32 Then there's always going to be someone whose willing to pay loads of money to have it done and someone who'll do it for them for all the money and stuff like that.

School A/Group 2

For a breakdown of beliefs explicitly expressed within each group see Appendix 8.

3.2.3 The acceptability of different applications of genetic engineering

In considering the acceptability of different applications of genetic engineering, there were four possible views - unqualified acceptance, provisional acceptance, rejection and 'undecided'. These are considered in more detail in Section 3.2.4. The extent to which each application was acceptable is shown in Table 3.3 below and a more detailed breakdown, by groups and by context, can be found in Appendix 9. In some groups members failed to reach agreement with each other and in these cases all points of view expressed within the group are recorded. In addition some groups ran out of time and were unable to discuss 'High Yield Crops' or 'Scorpion Venom Pesticide'. For these reason the total number of views does not always match the number of groups (15). In total, 89 views on different aspects of genetic engineering were expressed.

Table 3.3 - Acceptability of specific applications of genetic engineering

Application	Point of View				number of views expressed
	acceptable	not acceptable	provisionally acceptable	unresolved	
human growth hormone	0	2	10	5	17
gene therapy:					
a)somatic	1	1	9	4	13
b)germ line	0	5	4	5	14
c) no differentiation	0	0	0	2	2
the oncomouse	0	6	9	2	17
high yield crops	8	2	2	2	14
scorpion venom pesticide	3	5	0	4	12

The most acceptable of these applications of genetic engineering were the production of high yield crops, the production of human growth hormone and the use of somatic gene therapy. Of these, only the production of high yield crops was accepted unconditionally by the majority (8/14 responses). In the other two cases the majority view was that acceptance was provisional.

Responses to the oncomouse were highly polarised. Half the responses indicated a provisional acceptance of the oncomouse but one third of responses rejected it unconditionally. Very few responses were undecided.

The greatest uncertainty was shown in response to germ line gene therapy, were almost half of the responses were unresolved, but this included two responses which failed to distinguish between germ line and somatic gene therapy.

Overall, germ line gene therapy and the scorpion venom pesticide were considered to be the least acceptable of these uses of genetic engineering.

Most groups reached consensus on all contexts. Four groups were unable to do this (see Table 3.4). The difficulty seemed to result from the existence of strongly held beliefs within these groups rather specific issues arising within a particular context:

37.3 *I don't think people should be like messed around with I think they should just left the way like they're supposed to be. I mean I know if they don't have the growth hormone that ... that's the way they were supposed to be, actually supposed to be.*

I ***(..) are you telling me that we just don't know enough about it and there are problems that might happen that we haven't thought of, is that what you mean (...)?***

42.1 *Yeah.*

42.2 *I don't think it should be done at all. I don't think they've got the right to do it.*

(...)

46.1 *I think we all think really differently. Well, I think we think differently about it.*

(...)

I ***Have you changed your minds a bit as the discussion went on?***

52.1 *Yes.*

I ***[to another student] You haven't?***

53.1 *Emma's not persuaded at all.*

School A/Group 5

3.2.4 Criteria influencing the final viewpoint

In general, there was little interest in or concern about the direction of transfer of genes. Of more importance was:

- the organism being used (in general the use of plants and bacteria was more acceptable than the use of animals; the use of animals which were considered to be unpleasant was more acceptable than the use of those which were considered to be attractive);
- the amount of suffering it would cause (this was usually considered relative to the benefits - some animal suffering may be acceptable if it reduces lots of human suffering);
- the purpose for which it was being done (serious medical reasons were usually acceptable, 'frivolous' reasons - social advantage, personal preference - were not usually acceptable);
- the effectiveness of the technique or product and
- the possible risks and consequences.

In some cases criteria came into direct conflict with each other and the relative importance of each had to be considered. For example, in considering the oncomouse two important criteria were the amount of suffering caused to the organism and the extent of the benefit to humans:

32.2 *Yeah I think we thought medical reasons because its certainly going to be maybe a few mice and its going to save quite a lot of lives. So thought in the end it was working out as an advantage rather than just killing a mouse.*

School A/Group 4

13.72 *Its not very nice is it?*

13.73 *Its not natural.*

13.74 *No but they've got to find a way somehow haven't they?*

13.75 *Yeah but how many mice are going to get killed. I know like its going to cure people...*

13.76 *I know there's millions and millions of mice killed.*

13.77 *Its the only way we're going to find a cure.*

(...)

60.2 *If you could save thousands of people from dying with*

a few mice, it'd be a good idea.

School A/Group 7

Groups were not able, in all cases, to resolve such conflicts.

The key criteria which determined the final response to a specific use of genetic engineering are listed in Appendix 10 a-d and summarised in Appendix 11.

Unconditional Acceptance

As shown in Table 3.3, very few responses indicated an unconditional acceptance of any form of genetic engineering (12 out of the total of 89 views identified in Section 3.2.3) and the majority of these related to high yield crops. The defining criterion in over half these cases was the students' attitude towards the organism involved - '*not bothered about plants*', '*scorpions hurt you*', '*insects are pests*'. The effect on the organism was also taken into account - '*plants can't feel pain*'. For more details see Appendix 12a.

Rejection

Almost twice as many responses rejected some form of genetic engineering (21/89 views), most frequently germ line gene therapy, the oncomouse and scorpion venom pesticide.

Personal beliefs and ethical values were important criteria here (9 and 4 mentions respectively):

58.1 *I don't think it should be done I mean people who have got Cystic Fibrosis then like I think they were meant to have it. Erm, it was just meant yeah. I don't think they should try and get rid of it because that was the way they were meant to be.*

School A/Group 5

16.73 *People are always on about humans and how its so bad telling people they've got cancer. But yet they're like making mice to have cancer. It's just a ..*

16.74 *If they do it on summat else that's not like an animal that's alright. But to like use an animal.*

16.75 *It's not fair, I mean they wouldn't like test on humans to try to treat a mouse.*

16.76 *And mice aren't like humans anyway. Probably affect them in different ways as well.*

16.77 *So that's a definite no.*

School C/Group 5

Anxiety about the risks involved and the possibility of undesirable consequences were also an important influence (11 mentions):

35.66 *(...) I mean its like good for the environment and all that (...)*

35.67 *Yeah but then it'll kill all the birds.*

35.68 *Yeah, yeah, cos of all those that eat them...*

35.69 It gets rid of all pesticides and stuff which is like bad to the environment and all that stuff. But then it kill all the caterpillars and then hedgehogs and birds and then what eats the birds and things. (...) everybody's going to die.

School A/Group 5

For more details see Appendix 12b.

Provisional Acceptance

More than one third of all responses (34/89 views) expressed a provisional acceptance of some form of genetic engineering, most frequently human growth hormone, somatic gene therapy and the oncomouse. In the majority of these cases (28/34 views) the defining factor was the purpose for which it would be used. However, in most cases this was not considered in isolation. Instead there was a weighing up of costs and benefits. In general, if other organisms were to suffer, personal beliefs were to be set aside and risks with our future were to be taken then it had to be for a good reason. Under these circumstances genetic engineering was only acceptable if it was to treat or cure a serious medical condition - preferably one which could not be prevented and for which no alternative cure or treatment was available. There was extensive and sometimes heated discussion in some groups as to what should be considered 'serious' and a recognition in some cases that their personal view of this would change if they, or someone close to them, would be personally affected by the decision. In some cases (5/34 views) acceptance also depended on the existence of adequate controls:

29.19 It is a good idea really, if you've never been that small I don't think you can ever understand like how good it is really.

29.20 I know but people get a good chance of being ugly and stuff like that. And they're going to be bringing out all these ....

29.21 Can't correct everything and everyone.
(...)

29.25 Well do you think they should still be at two foot when they're 18 or whatever? That they should be like really small? I think if they want, if they can, to be average height not taller. I mean the other thing I've noticed they're still going to be below average height anyway. Its just to get them like above a bit. I mean ...

29.26 Yeah but the thing with this is like its like bound to get in to like the wrong hands as well, you know what I mean? Like people who are already tall are going to get really tall and like the basketball ...

School A/Group 2

For more details see Appendix 12c.

Undecided

A substantial minority of responses (24/89 views) could not decide whether or not a particular form of genetic engineering was acceptable. There appeared to be two main causes of this uncertainty:

1. Unresolved conflict between a belief that it was fundamentally wrong in some way and a recognition that under some circumstances it might be desirable (7 cases).
2. Anxieties and doubts which could not be evaluated in a quantifiable way (17 cases).

These were not mutually exclusive:

I ***So what did you think about gene therapy?***

(...)

I ***Are you saying then its okay to use it as a treatment for an individual but not to alter all the other generations that come, not to have that treatment passed on.***

35.1 *Yeah but wouldn't that just mean that you'd have to keep giving the whatever it is genes to the children? Because they'll get it as well won't they?*

35.2 *(...) it should be up to the parents or whatever.*

(...)

35.5 *No but I think they should get rid of the disease if they can see it in the genes.*

I ***Are you saying then that you think it would be good to (...) change the parents eggs or sperm so that they're children would never have it?***

36.1 *Yes so you'd get rid of the disease.*

36.2 *But the children might not have CF and then what's that going to do to them?*

36.3 *It won't do anything.*

36.4 *It might*

(...)

36.6 *(...) I mean is that going to mess their genes up or what. I mean, we don't really know.*

36.7 *If there's anyway that it's going to harm the child it shouldn't be done. Cos that is a new life and if that's going to harm then its not right. I think it would be better to actually, you know, treat them afterwards - like you treat the parents.*

(...)

36.11 *No, but its' the parents choice isn't it?*

I ***You seem to be saying something quite important about choices and rights and who should make the choices is that right?***

(...)

37.1 *It's the parents choice.*

37.2 *But there's no point making the child have CF if it doesn't need it. If you..*

I ***If you could prevent it, is that what you're saying?***

38.1 *Yeah, summat like that.*

I ***You've been talking about two different things here, one moment you've been talking about using gene therapy as a treatment(...) and you've also been talking about changing eggs and sperm in humans so that they're children didn't also get CF and you seem to have mixed feelings. How would you feel about changing eggs and sperm in animals to improve them?***

39.1 *No I don't think that's right.*

39.2 *No cos they can't tell you 'oh I don't want that' because they can't talk to you. So it's best left alone. Again its messing around with nature isn't it, because nature doesn't need to be messed about with. If it you know, nature should only be messed about with where it needs to be. If its a matter of life and death.*

School C/Group 5

In addition, two groups felt that there would be so many conditions attached to their acceptance of a particular use of genetic engineering that they would have to decide each case individually.

The focus of concern was on the long term risks and the difficulties of control. Doubts about the real or relative benefits were also mentioned - can results from mice reliably inform us about humans? Is this an appropriate use of resources?

Again, reasons for considering provisional acceptance focused on the purpose for which it would be used - it would only be acceptable for serious medical illness. The issue of 'control' was often linked to views on provisional acceptance - doubts about the possibility of controlling the way in which something would be used, once it was available, was the reason why many remained undecided. For more details see Appendix 12d.

The views of each group, for each context, are presented in Appendix 13 and the criteria which determined these views are summarised in Appendix 14.

3.2.5 Reasoning within the groups

Engagement with the task

As shown in Table 3.4 (page 32), most groups were willing to engage with the tasks. However, the extent to which some groups engaged - as reflected in their willingness to read the materials, the speed with which they considered each context and the extent to which they were side-tracked - was limited. For a number of reasons class B were very unsettled and one group was disruptive to the point that interviewing could not continue. Despite this, some members

of Group B2 did become engaged with the tasks with the help of the interviewer, who read some of the text to them.

Quality of discussion

Mercer (1996) suggests three ways of describing small group discussions:

1. *Disputational talk,* involving short exchanges between students which are characterised by individual decision-making or disagreement between students; there are no apparent attempts to pool ideas, to reach decisions, or to offer constructive criticism to ideas raised by others.
2. *Cumulative talk,* involving speakers in building positively and uncritically upon everything that is said in discussion.
3. *Exploratory talk*, during which speakers engage in critical but constructive discussion about each other's ideas; when challenges are made, they are backed up with argumentation and alternative viewpoints are suggested.

Mercer's categories seem to focus on the reflective nature of the discussion and the effect this has on the development of reasoned argument:

- in *disputational talk* points might be ignored, or disagreed with (without any justification), as a result no coherent line of argument develops and points are unrelated;
- in *cumulative talk* points are unreflectively and uncritically accepted, as a result single lines of argument are re-enforced and comments build on each other;
- in *exploratory talk* points are constructively criticised, as a result lines of argument are challenged and alternative views are considered.

This approach to categorising discussion provided a useful starting point for considering the quality of discussions in this study. However, no single group fitted clearly into any one category. Using this approach, many groups showed intermediate forms of discussion and most groups moved between the different forms of discussion as they moved between contexts. Quality of discussion seemed to be influenced by such factors as the group's interest in the topic, the extent of their prior knowledge and experience and the extent to which group members were in agreement with each other. In some groups the form of the discussion changed within a single context, for example in response to a change in the direction of the discussion or to the raising of a new point. In the following extract the group are considering the use of gene therapy. The form of the discussion changes from disputational talk (but without any disagreement) to more exploratory talk when one person starts to reflect on the statements presented on the card. This is followed by uncritical agreement from several members of the group which could perhaps be considered cumulative talk but doesn't actually add anything to the discussion:

15.37 I disagree with both of them.

15.38 I think the person who said statement 2 want's shooting.

15.39 I think it should be allowed to cure illness.

[Disputational talk changes to more exploratory talk]

15.40 Erm I'm sure they'd [referring to the people making the statement on the card] have a different, have different idea really if they had an illness would they?

15.41 I think they should be able to cure illness but not mess about with the old sperm, eggs, sperm and eggs. I don't think they should change someone.

15.42 Only thing is - you can do it.

15.43 If you can do it properly then you might as well change them but its just like, if its just like going to be haphazard ... only might work then there's no point doing it cos if your going to be cured of an illness, that's something.

[Exploratory talk changes to uncritical agreement]

15.44 Well absolutely.

15.45 Absolutely.

15.46 Yes that's what I say.

15.47 Is that it then?

15.48 Yes so we agree with number one don't we.

15.49 We agree with the first one.

School C/Group 2

The range of criteria considered during the group discussions was also used as an indicator of the quality of discussion. In general, the larger the number of criteria considered, the better the quality of the discussion. Although it was possible that some groups might consider a large number of criteria superficially while others might consider only a few but in some depth, this did not seem to be the case - as the following two extracts illustrate. In these discussions on the oncomouse, taking place in the absence of an interviewer, Group A3 considered 9 different criteria (criteria 1a, 1b, 3a, 3b, 4a, 8b, 9b, 10 and 11b; see Appendix 7), challenging, evaluating and considering their relative importance through exploratory talk. Group A6 considered only 3 criteria rather superficially, before being side-tracked into a discussion of the weird and wonderful (criteria 1a, 3b and 11b).

School A/Group 3:

[Animal rights (11b) are raised early in the discussion.]

21.42 (.....) Cos its just getting on to the whole issue of animal testing and whether its right to make animals suffer for something which we ...

[The discussion then becomes an evaluation of the importance of this criteria, drawing on a consideration of the origin of the oncomouse (1b)..]

21.43 I disagree... because the mouse has obviously been produced for a particular purpose. It isn't as if you've gone like and got a normal mouse and ...

21.44 Yeah but they would have had to get the mouse from somewhere first.

[...the relative costs and benefits (8b)..]

21.45 Yeah it was only one mouse.

21.46 It doesn't change the fact that animals still have to suffer the...

21.47 Oh yeah I'm not saying that they should but if like, if you can .... I don't know ...

21.48 I think it would be great to get rid of cancer.

21.49 Oh definitely.

[... possible alternatives (3b)]

21.50 But it would be better to do it a different way.

21.51 Yeah I don't think its right to sort of deliberately like say deliberately design an animal so that it suffers but if you (...) could take something from that animal ...

21.52 Its not as if your doing it to an animal that already exists. I mean I know you'd have to get a mouse like a normal mouse in the first place but (...)

21.53 It depends on what, go on.

[... and the relative importance of different organisms (1a)]

21.54 It all goes down to what you, what you think sort of ... what life is more important I mean if you think that ... whatever your view might be, however you felt ... if you believe that to have however many mice die because of wanting to develop that research then...

[They also consider the potential conflict between personal belief and personal needs (10, 9b) ...]

21.55 Like I think if it was you, if you had cancer and you thought they could find a cure would you have them test it on mice, you'd say yes. But its getting into that other side it is messing with nature that they're just doing the opposite of what people want to do which is get rid of it. I know its a mouse but ...

[and the probable effectiveness of the approach (4a)]

21.56 Would you, would you trust like sort of what they'd found out from testing a mouse?

21.57 I know, well they're not the same are they

21.58 You see you never sort of hear of the actual test on humans. (...)I think testing sort of testing medical things on animal I think there are arguments for that for actually developing an illness in animal. Designing specially for that purpose. But I mean on the other ... I mean if you could take something from that mouse and develop that then that's fine but they obviously can't do that cos otherwise they wouldn't be doing that.

[before returning to a consideration of the relative importance of different organisms.]

21.59 Yeah, they would, they wouldn't dream of doing that to a human, they wouldn't dream of producing a human deliberately with cancer that's guaranteed to suffer would they?

21.60 No.

21.61 Yeah I know cos (...) the majority of people value a human's life more than a mouse.
21.62 Exactly, yes.
21.63 Well they do yeah but it gets down to what you value.
21.64 No I'm not saying it is right but there's like thousands well hundreds of people who die of cancer a year you know, that's one mouse.

[The remainder of the discussion was spent revisiting criteria considered earlier from a slightly different perspective]

21.65 Yeah, but that's not the only way to (...) research cancer is it?
21.66 Has anybody ever thought of another way (...)
21.67 Yeah, there's lots of other ways they can do it.
21.68 (...)I would like to think that this, if this was the only way then people would consider it more but I think, I like to think they're only suggesting this. That there is absolutely no other way you know they've found so far...
(...)
21.70 I mean look at the other options...
21.71 It's really whether you could sort of get rid of cancer actually.
21.72 (...) I just feel really sorry for the mouse.
21.73 Well (...) I'm sorry but I can't really be bothered about a mouse
(...)
21.76 Yeah but its not that (...) its the whole principle...

In contrast, School A/Group 6:

17.54 What they should do (...) they should test the treatments on people who've already got cancer.
17.55 Yeah.
17.56 But they might not want to and they might die.
17.57 Well they're going to die anyway.
Yeah
Yeah
17.58 They might not.
17.59 Yeah but they might not die instantly
17.60 I don't think they should breed summat just to ...
17.61 No neither do I.
17.62 No, cos we're against animal testing.
17.63 But they should try it on someone whose only got cancer, whose going to die anyway so.
17.64 Cos that's what they did with my granddad when he had this weird disease. Trying all these weird things on him.

Using these two factors as a guide, but recognising that any assessment of the quality of discussion is likely to be subjective, the discussion in each group was described as good, average or poor (see Table 3.4). The following characteristics were used to define these categories:

- *'poor'* - the number of criteria considered was limited and the discussion was predominantly disputational/cumulative talk, even with the support of the interviewer;
- *'average'* - two different sets of characteristics where apparent in group discussions classified as 'average'; discussion in some of these groups began poorly, with consideration of a limited number of criteria and discussion which was predominantly disputational/cumulative but, with support from the interviewer, these groups moved towards cumulative/exploratory talk; in other groups a larger number of criteria were considered and the talk was mainly cumulative, interviewers appeared to have little effect on the quality of discussion in these groups;
- *'good'* - these group discussions were characterised by consideration of a wide range of criteria and a predominance of cumulative/exploratory talk; interviewers appeared to have little effect on the quality of discussion in these groups.

Table 3.4 - profile of the individual groups

	Groups													
Characteristic	**A1**	**A2**	**A3**	**A4**	**A5**	**A6**	**A7**	**B1**	**B2#**	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**
engagement with task	ok	ok	ok	poor	ok	ok	ok	poor	poor	poor	ok	poor	ok	ok	ok
number of criteria considered:-															
a) in discussion	17	25	18	11	15	17	20	11	12	12	11	12	12	23	13
b) influencing final view	10	10	8	5	10	8	11	6	9	4	4	7	7	10	9
unresolved contexts	svp	hgh sgt svp	hyc onco hgh gt		hyc	ggt	svp hgh		gt	ggt		svp	ggt	hgh ggt	
consensus within the group?	no onco	yes	yes	yes	no hgh ggt sgt hyc	yes	yes	yes	no onco hyc	yes	no hgh	yes	yes	yes	yes
quality of student discussion *	ave.	ave.	good	ave.	ave.	poor	ave.	poor	ave.	poor	poor	ave.	ave.	good	ave.
interviewer effect on discussion?	yes -ve	no	no	yes +ve	no	no	no	yes -ve	yes +ve	yes +ve	yes -ve	yes +ve	no	no	yes +ve

hgh - human growth hormone sgt - somatic gene therapy ggt - germ line gene therapy
onco - the oncomouse hyc - high yield crops svp - scorpion venom pesticide
gt - gene therapy (no distinction between somatic and germ line)

\# Class B as a whole were very unsettled and found it difficult to engage with the task; one group was so disruptive that interviewing was abandoned (this group was not included within the analysis).

* 'quality of discussion' is loosely based on Mercer (1996); it is considered in more detail within the text, together with other relevant factors.

Influences on the quality of discussion

It might have been expected that in groups which couldn't reach agreement individuals would be pushed into justifying their own views and criticising the opposing views and that this process might increase the quality of discussion within the group, but this was not necessarily so. In some cases the differences arose because some group members had strongly held beliefs which prevented them from engaging with the issues in an analytical or evaluative way.

In a similar way, it might have been expected that when groups had difficulty deciding on their view about a particular context then they would be forced to be more articulate about the relative importance of different criteria and so improve the quality of discussion. Transcripts were not analysed to pick this out but in Table 3.4 there is some indication that this might have been the case. Of the four groups where the quality of discussion was considered to be poor, two groups had come to a view about all contexts and two groups had come to a view about all but one context - germ line gene therapy.

A more important influence on the quality of the discussion seemed to be the interviewer. Through discussion with the interviewer many groups were pushed into making their reasoning more explicit. This process helped to develop their awareness and understanding of what they were being asked to do. However, this was not always the case. In a few groups the interviewer appeared to have a negative effect on discussion. In one further group the poor quality of the discussion failed to improve in response to questioning by the interviewer. With the exception of Group B1, who were interviewed by their own class teacher at a time when the entire class was unsettled, it is difficult to see why this was the case.

4 Discussion

4.1 Understanding the science

Initially, students had some difficulty with three particular genetic concepts:

- the concept of differential gene expression (the idea that all the somatic cells of an individual contain the same information, but only some of it is used in any one type of cell);
- the distinction between somatic and germ cells, and
- the distinction between the genome and the genetic code.

Similar difficulties have been identified in other areas of the project (Lewis *et al*, 1997).

Through discussion, sometimes in the presence of the interviewer, most groups came to accept a scientific view of differential gene expression. Recognition of the difference between somatic and germ cells was also achieved after discussion, but sometimes only after the interviewer had made the different implications for gene therapy explicit. Even then, two groups did not appear to recognise the distinction.

Difficulties with the distinction between 'genome' and 'genetic code' seemed to be of a different order. Many students did not appear to recognise that two quite separate concepts were involved and seemed unable to distinguish between the message (information in the genes) and the language (or code) in which that message was written. As a result, they were inclined to be dismissive of the notion of a universal genetic code - dogs and plants were clearly very different things, therefore they *must* have different codes; if they had the same code they would be very similar things. Many groups maintained this belief despite the best efforts of their interviewer.

From the above points it can be seen that discussion of key concepts, within a specific context which the students can relate to, did help students to develop their scientific understanding. However it was not always enough, at least within the time available to us. Possible reasons for the students' difficulty with the concepts of genome and genetic code are discussed in Working Paper 2 (Lewis *et al*, 1997).

4.2 Coming to a view

Almost all students were able to engage with the task in a thoughtful way despite their lack of prior knowledge or experience The information cards often provoked an emotional response from the students, which helped to stimulate their interest, and interviewers provided the extra push which was sometimes needed to stimulate a more considered response. Some groups also needed the stimulus of the interviewer in order to organise and articulate their ideas and to justify their viewpoints. This was probably due to a combination of inexperience (at tackling this type of task), uncertainty (about what was required) and a lack of self discipline and/or motivation. Overall

the quality of the discussion was variable, even within a single group, but in most groups at least some of the discussion was good (see Section 3.2.5).

In discussing the different contexts presented to them, students drew on a number of their own ideas and experiences in addition to those identified for them in the stimulus material. Although strong personal beliefs were expressed in many groups, all groups considered a range of criteria in trying to reach a view. In general they were cynical about human nature, maintaining that once something was possible or available there would always be someone willing to do it, sell it or buy it - whatever controls were imposed. There was an almost fatalistic belief, not obviously connected to religious belief, that things are as they are for a reason. The feeling seemed to be that in using genetic engineering to change things a natural balance would be disturbed, with unpredictable and possibly dangerous consequences. In part, their sometimes critical view of science and scientists - that scientists were prepared to ignore potentially dangerous long term risks for the sake of short term interests - seemed to stem from this.

Their view of the relative importance of animals was complex. Distinctions were made between animals that had a sentimental appeal for humans and animals which evoked fear or distaste. Although there was a tendency to be sentimental about animal welfare the students were pragmatic, recognising that most people would consider human needs and rights as more important than animal needs and rights. They also recognised that this would become more apparent when an individual was personally affected. In many cases their concern for animal rights was not simply a sentimental response to animals but seemed to be part of a more general belief in the right to self determination - that nothing should be done to an individual without that individual's consent. This view was not restricted to human contexts. As one group put it - if it's not right for humans then really it's not right for animals either. Other groups seemed to be expressing similar sentiments when they said that it wasn't right because animals couldn't tell you what they thought or how they felt. These mixed views on the relative importance of different animals led to a balancing of costs and benefits - how many mice were likely to die and how many human lives would benefit (and how certain and how great was the benefit)?

In justifying the view which they finally came to, groups specifically mentioned a number of the criteria which had been considered during their discussion. One criterion - the use to be made of the technique or the product - appeared to influence the final view more often than any other (see Appendix 11, criterion 2a). Other factors which appeared to have an important influence on the final view were:

- the type of organisms involved and their relative importance (1a);
- concern that the process and/or product were unnatural and that their use would be 'messing with nature' (9b) and
- the effect of the process or product on the organisms involved (1e).

During discussions there was little evidence that students were making use of the genetic concepts which they had encountered earlier in the task. The exception was their discussion of gene therapy, but this was usually in response to pressure from the interviewer.

4.3 Educational implications

Individuals are increasingly faced with decisions resulting from the social implications of science, especially in the area of genetics, within their personal lives. At present teaching about such issues, and the decision making skills needed to respond to them in a reasoned way, is very limited within the compulsory science curriculum. The need to develop a general curriculum which would address these issues and would equip all students with the necessary skills is currently being discussed. The findings from this study show that, with the use of appropriate materials and support, most students of this age can engage in a meaningful way with science issues and come to a reasoned view. Although a good understanding of the genetic concepts which underpin such issues may be desirable, it does not appear to be essential for the decision making process - in most cases well reasoned discussion can take place without any reference to the science. Conversely, it is possible that discussion of such issues, which have some interest and relevance for the students, may stimulate their interest in the underlying science. There was some evidence from this study that discussion of genetic concepts within a specific context led to a better understanding. For a more detailed discussion of this and other educational implications see Leach *et al*, (1996).

A note on the format of transcript used in this report

Verbatim transcript is presented in italics, inset from the margins. The letter '***I***' and ***bold*** print denotes that the interviewer is speaking. Line numbers and normal print denotes that a student is speaking. The analysis was at the group level and no attempt has been made to identify individual students. Line numbers give the location of the extracts within the whole transcript.

2.31 *This format denotes student talk. The notation (...) on a line indicates that part of an utterance has been edited. [Indicates additional information provided by the researcher to aid understanding of the quote]*

(...)

I ***This format denotes interviewer talk. The notation (...) above a line indicates that one or more utterances have been missed out completely.***

In order to enhance comprehension, the transcript has been 'cleaned' to remove repetitions and other 'noise'.

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Appendix 1

The video script: background information on genetic engineering

- Over the last 20 years there has been a revolution in the science of genetics which has led to the development of a whole new technology - DNA technology. In the near future, all our lives are likely to be touched by new applications of DNA technology. The potential of this new technology has caught the public imagination and 'Jurassic Park', a film about scientists recreating dinosaurs through genetic engineering, was hugely successful.
- Although 'Jurassic Park' was a work of fiction, and geneticists *can't* recreate extinct life forms, what *can* now be achieved is almost as astonishing. Every week, new developments are reported on TV , and in magazines and newspapers.
  So what is the science of genetics all about and what is DNA?..
- Geneticists look at what makes living things the way that they are and a chemical, deoxyribonucleic acid (or DNA for short) can provide some of the answers. This chemical is found in the cells of all living things.
- All plants and animals are made up of cells. Cells are very small indeed - for example, in this sheep there are many millions of cells, and each one is so small that a microscope is needed to see it.
- The cells that we can see in this picture have been taken from a sheep. You can see the cell membranes, which separate the cells from each other. And inside each cell, you can see a [dark] area which is called the nucleus.
- The nucleus of the cell contains chromosomes. Usually these are long thin threads which are impossible to see, even with a microscope, but sometimes they coil up tightly, becoming much shorter and fatter. When they are like this they *can* be seen, with a powerful microscope.
- Human chromosomes look like this when coiled up.
- Chromosomes are very important, because they contain the cells' DNA.
- DNA is so thin that it can *never* be seen with an ordinary microscope but if we *could* see it, it would look something like this:
  Pause

- It is incredibly long and tightly coiled, so that an enormous amount of it can be packed into a single chromosome.
- DNA is made up of sub units. There are only four different types of sub unit([coloured red, yellow, green and blue] in this diagram) but millions of them are linked together to form one single strand of DNA. The sequence of different sub units produces a coded message which tells the cell how to make the things it needs.
- The code which is used is called 'The Genetic Code'.
- The messages in the DNA are broken down into genes. Each gene contains information needed to make just one of the many things which the cell needs.
- It is the genetic information in the genes which makes living things the way they are. For example, the genes in grass cells will contain different information from the genes in dog cells; the genes in dog cells will contain different information from the genes in human cells.
- Different living things contain different genetic information, but cells from all living things read the genetic code in the same way. This is important for geneticists : for example, it means that grass cells can understand the information in dog genes or dog cells can understand the information in human genes.
- Geneticists can now take advantage of this fact. Recently they have learnt how to identify useful genes, how to cut and copy them *(use a word processor e.g.)* and how to move them about between different kinds of cells. The use of these techniques is called 'genetic engineering'.
- For example, if the human gene which tells a human cell how to make insulin is put into a bacterial cell, the bacterial cell will be then able to make human insulin.
- The following example shows how genetic engineering works in more detail.
- Flowers come in wide variety of colours and shades.

  Pause
- If you look just at roses, though, there is one colour that you never see - blue.
- Many rose growers wish that there was a blue rose and rose breeders, aware of the potentially valuable market, wish they could produce one.
- By cross-fertilizing different coloured roses, rose breeders have produced a whole range of interesting new varieties - but so far no-one has been able to produce a blue

rose. This is because no rose cell contains any genes which code for blue flower pigment. With the aid of genetic engineering this could all change.

- Although there are no blue roses, it is not hard to find other species with blue flowers. Geneticists are attempting to find the gene that codes for the blue pigment in these flowers, and insert it into rose cells
- For example, by taking one cell from these lobelia plants, the geneticists could attempt to find the gene for the blue pigment in the laboratory.
- Although identifying the gene is a fairly complex procedure, it can now be done.
- Then, the part of the DNA containing the gene for blue pigment is removed from the lobelia cell and copied hundreds of times. The resulting fragments of DNA are minute - much too small to see even with the most powerful of microscopes.
- These copies are then added to rose cells. If just one rose cell takes the gene for blue pigment into its own DNA it should be able to make its own blue pigment. From that one cell the plant breeders would be able to grow a blue rose and from that one rose they could grow many more.
- So far, scientists haven't managed to put a working 'blue' gene into a rose cell but the race is on....
- single root or shoot tip from a plant will contain many thousands of cells, so collecting cells for these experiments doesn't harm the plants at all. The same is true for similar experiments using animal cells - for example in human beings cells can be washed from the inside of the mouth without harming the person at all.
- Making blue roses might not seem a very important application of DNA technology. But other applications may have important consequences in medicine, industry and agriculture.
- For example, bacterial genes are being added to plant cells to make crops resistant to pests and human genes are being added to sheep cells so that the sheep will produce human proteins in their milk; proteins like insulin, for treating diabetics, and factor 8, for treating haemophiliacs.
- However, along with the possible advantages come potential difficulties. In this session, you will be working in groups to consider your views about the advantages and disadvantages of genetic engineering.

- But first, you'll have the opportunity to make sure that you have understood the background information in this video.

Appendix 2

Contexts and Criteria

The purpose of this task was to probe the extent to which young people think there should be limits to the use of genetic engineering. The following criteria were thought to be potentially important factors in determining where the limits of acceptability for genetic engineering lay:-

- **type of organism** (human, other vertebrates, invertebrates, plants, micro-organisms)
- **nature of organisms** (domestic vs 'wild')
- **nature of transfer** (within species, between species, including /excluding human genes)
- **purpose of the application** (medical treatment, medical research, social advantage/control, increased food production)
- **effect on organism** (no effect, harmful, lethal)

The five contexts listed below were chosen to cover as many of these criteria as possible:-

1) production of **Human Growth Hormone**

The transfer of genes is *between* species :
- from human to sheep
- from human to bacteria

These organisms are :
- human!
- domesticated (sheep)
- wild but cultured (bacteria)

The product is used for :
- medical reasons (treatment of HGH deficiency)
- social reasons (social advantage of tall people)

The effect on the organisms is :

a) sheep - little effect on successfully manipulated mature sheep
- possibly disastrous effect on embryo if manipulation unsuccessful

b) bacteria - no apparent effect

2) Gene Therapy

The transfer of genes is *within* species :
- from human to human

The organism is :
- human

The possible uses are :

a) somatic gene therapy (currently under research)
- only affects selected cells within one individual
- medical use only (treatment of genetic disease, cancers)

b) germ line gene therapy (currently prohibited in humans)
- alters eggs and sperm, therefore all subsequent generations
- social/medical use (eradicating genetic disease)

- social use (selecting preferred characteristics)

The effect on the organism is :

- benefit if use as treatment successful
- severe/fatal illness if treatment goes wrong
- unknown risks to embryo

3) production of **The Oncomouse**

The transfer of genes is *within* species :

- from mouse to mouse

The organism is :

- domestic (laboratory bred mice)

The product (the 'oncomouse') is used for :

- medical research (to test the effectiveness of cancer treatments)

The effect on the organism is :

- harmful, eventually lethal

4) development of **Scorpion Venom Pesticide**

The transfer of genes is *between* species :

- from scorpion to virus

These organisms are :

- wild (scorpion)
- wild but cultured (virus)

The product (the genetically engineered virus) is used as :

- a pesticide (sprayed onto cabbages, infect caterpillars, venom gene becomes activated, the venom produced kills the caterpillar)

The effect on the organism is :

- non apparent

(but note : purpose is to kill caterpillar, which is not itself genetically engineered)

5) development of **High Yield Crops**

The transfer of genes is *between* species :

- from plant species A to plant species B

These organisms are :

- wild plants
- cultivated plants

The purpose is to :

- increase food production

The effect on the organism is :

- non apparent

Appendix 3

The Information Cards

3a: Human Growth Hormone

* In humans, growth is controlled by a hormone.

* Sometimes the gene which produces this growth hormone doesn't work properly and no growth hormone is produced. Children who cannot hormone don't grow.

"I don't think human genes should ever be put into animals or bacteria just so that some people can grow extra tall."

* The human gene for growth hormone has now been put into sheep, so that the sheep produce the hormone in their milk. This doesn't hurt the sheep at all.

* The milk is collected and the growth hormone is separated out. It can then be given to these children so that they can grow.

* Human growth hormone is also produced by putting the human gene into bacteria.

* If extra growth hormone is given to children who already produce their own hormone, they will grow extra tall.

'I think it's a good idea if it means that affected children can grow normally."

* Some people believe that tall people have lots of advantages in life. For this reason some parents would like to give their children extra growth hormone.

3b: Gene Therapy

* In humans, some illnesses e.g. Cystic Fibrosis, are caused by genes which don't work properly.

* If the faulty gene could be replaced by working copies of the gene, the illness could be cured. This is called gene therapy.

* But the disease could still be passed on to any children. Only by altering the eggs and sperm can the disease be got rid of completely.

* If it were possible to alter the genes in eggs or sperm for medical reasons it might also be possible to alter other genes for other reasons.

* At the moment, scientists are not allowed to change the genes in human eggs or sperm.

" Gene Therapy seems like a good idea. I think it's time they started work on eggs and sperm."

" Gene Therapy should never be used, not even to cure illnesses "

3c: The Oncomouse

* The oncomouse has been genetically engineered to develop cancer.

* It was originally produced by combining genes from several different laboratory mice.

* The result was a mouse with known and pre-selected features which was guaranteed to develop cancer.

* Once one oncomouse had been produced a limitless supply could be produced naturally, by reproduction.

* The oncomouse was developed for use in cancer research, to test the effectiveness of different treatments.

"It's OK to use animals in this way if it makes cancer treatment more effective and helps to save human lives."

"It can never be right to deliberately design an animal which is guaranteed to suffer"

3d: High Yield Crops

* Cultivated crop plants are sometimes less sturdy than wild plants.

* By adding genes from wild plants to cultivated plants, stronger cultivated plants can be grown .

* These genetically engineered plants are less easily damaged. As a result, they will produce more food than normal crop plants.

"Moving genes about between different living things can never be right"

"There's nothing wrong with moving genes about between different plants"

3e: Scorpion Venom Pesticide

* Genetic engineering can be used to protect crops from pests.

* The scorpion gene which produces venom has been put into a virus which infects caterpillars.

* This genetically engineered virus is then sprayed onto the crops.

* When caterpillars eat the crops, they become infected with the virus.

* Once the virus is inside the caterpillar it produces scorpion venom, which kills the caterpillar.

"I don't like this idea at all."

"If it protects the crops it's a good idea"

Appendix 4

The Audio Script: contexts and applications of genetic engineering

Narrator Pete and Julia are both studying for their 'A'-levels at sixth form college. Julia is doing biology, chemistry and physics, and Pete is doing economics, history and social studies. At the moment, they're in the process of making choices about what courses to do at University...

Pete I reckon I'm definitely going to apply for business studies courses.

Julia Why's that?

Pete Don't know really. Seems to me that at least I'll have some chance of getting a job at the end of it all.

Julia Sounds really boring to me.. working in an office and that.

Pete So what're you going to do then?

Julia Genetics!

Pete Oh! I can see that butchering thousands of laboratory rats is MUCH more fun than working in a boring old office... OW! [sound of Julia slapping him]

Julia You KNOW it's not like that - and what do you take me for, thinking that I'd do that sort of thing? These days geneticists tend to work with a few cells rather than loads of whole animals. Where've you been, anyway, haven't you heard of The Genetic Revolution?

Pete We did this thing in social studies... something about scorpions and crops. All sounded a bit far-fetched to me... they were on about taking scorpion venom genes and putting them into crops.. into the cells.. so they didn't get eaten by bugs and that. Sound's pretty neat to me.

Julia 'Into bugs and that..' VERY scientific! Actually, they put the genes into this virus, which they then infect the crops with. It means that they don't have to use so many pesticides, which are really bad for the environment.

Pete It'll put the pesticide firms out of business...

Julia But that depends on whether they do it more widely - at the moment it's fairly experimental.

Pete I guess.. I don't know how many people would want to eat scorpion genes with their Weetabix!

Julia Yeah, some people just don't understand that by the time that the wheat gets to them there'll be no danger. No, the thing that bothers me about it all is the thought of these genetically engineered viruses all over the place. Viruses can only live by infecting other living things. Usually they're quite choosy about which other living things they want to live in, but what if genetically engineered viruses are less choosy and start to infect other things? Could be scary!

Pete Like 'Jurassic Virus' or something? I don't reckon it's right to tamper with genes and then let things out into the wild. You just don't know what might happen.

Julia We did all this stuff in biology about the balance of nature - ecology and all that. This sort of thing is messing with the balance of ecosystems.

Pete But it does mean that less pesticides are used, and that we can make more food to feed the world. Someone must be making a packet out of this!

Julia Trust you to think of money! Actually, loads of biotechnology firms are taking out patents on the genes that they have decoded. Patents are..

Pete ..when you put a kind of copyright on something, to stop other firms from ripping it off. I'm the economist, remember!

Julia I don't think it's right for a firm to put a patent on genes.

Pete Oh yeah, then everyone'd rip you off after all the research you've invested money in.

Julia I don't think that they should be able to put a patent on genes. This sort of research should be used for the good of everyone, not just for one company's profit. They might decode one of yours and put a patent on you! How would you feel?

Pete Not really bothered. Can I ask a stupid question?

Julia That WILL be a first. Go on..

Pete Doesn't it hurt the scorpion to get its genes out?

Julia [laughs] 'Course not! they only take genes from the odd cell or two.

Pete Oh..

Julia I really want to be a part of all this. So much good can come from genetic engineering. So many medical cures..

Pete [whistles 'Dr. Kildaire' music] You going to save the world then?

Julia I'll do more than you, pushing paper across some boring desk. They can already make growth hormone in sheep.

Pete What?

Julia Yeah, they've taken the gene for human growth hormone from people, and put it into sheep. When the sheep produce milk, the milk contains human growth hormone!

Pete Yeah, yeah, yeah..

Julia No, seriously. They didn't used to be able to treat people with growth problems, but now they can.

Pete So they just give them this special milk, and...

Julia No, they get the growth hormone out of the milk, and then they inject it.

Pete Oh, OK, but I thought you said that you weren't keen on messing about with genes? Those sheep have got human genes in them now!

Julia Yes, but..... at least they're not released into the wild to breed. And for some things, like insulin for diabetes, they put the genes into bacteria, not animals.

Pete So it's OK to mess with bacteria genes, but not animals? Bit hypocritical, isn't it?

Julia I think it's just... different. Anyway, I think it's more OK if it's going to help people medically, than just make money for some company or make some farmer get better crop yields..

Pete But he'll also be helping to feed the world... and anyway, I've heard that some parents in the States pay for their children to have injections of growth hormone so that they'll be tall enough for the basket-ball team, so it isn't just used medically.

Julia Well, anything can be misused... I still think that some things are more OK than others.

Pete I heard this thing the other day about this genetically engineered mouse that gets cancer..

Julia It's called the 'oncomouse'. It's had genes put in it which make it get cancer, so that they can try to find a cure.

Pete Poor mouse.. I thought you said that you wouldn't be working with whole animals in genetics?

Julia I certainly don't want to - but sometimes it might be necessary. After all, if they could find a cure for cancer..

Pete I bet that the people who made this mouse are making a profit by selling it to other researchers, just like the scorpion venom scientists. But think of the poor little mouse, doomed to die of cancer from the day it's born. And the only hope is being killed by Julia... [second slap] OW!

[pause]

Pete Sorry.

Julia Good! Things like that are too serious to take the mickey out of. Do you know how many people die of cancer each year?

Pete OK, OK, I said I'm sorry. And I can see some good things that can come out of genetic engineering. Did you see that thing on telly last week about Cystic Fibrosis? They said that they could give people a good gene to replace the one that doesn't work, and cure them. And the best bit is, the new gene will be passed on to the children, and Cystic Fibrosis will disappear for ever. That's got to be good.

Julia Yes.. but they can't do it yet. My Dad says it's a bit like Nazi Germany.. you know, deciding what illnesses are acceptable and what illnesses are not. He thinks that if we get into that sort of thing we could all end up the same, like clones.

[pause]

Julia Overall, I think I'm in favour of genetic engineering, but it depends what for. Although I am a bit concerned about the idea of messing about with genes, I do think that it's acceptable for medical reasons. But I'm not convinced if it's just to make money for companies, and I don't think that they should be allowed to patent genes. And I'm happier about the idea of changing bacterial genes and plant genes than changing animal genes.

Pete I don't think you can have it both ways. If you think that changing genes is wrong it doesn't matter whether it's bacterial genes or human genes that are being changed, and doing it for medical reasons is no better than doing it for any other reason. And personally, I'm not happy about releasing genetically engineered organisms into the wild - we just don't know what might happen in the future. And I guess that includes Cystic Fibrosis - we're messing about with nature if we correct a faulty gene in such a way that it can be passed on from parents to children.

Julia I wish we'd never started this conversation.. I felt happy with doing genetics before...

TAPE ENDS

Lead Interviewer :-

Julia and Pete have hit upon a number of issues that may have to be faced because of the development of genetic engineering. Just like Pete and Julia, people in real life have different points of view about these issues - about what should, and what should not, be allowed.

Some of the ways in which genetic engineering has been used have been summarized on cards for you. Beside each summary are a pair of statements giving two different points of view.

We would like you to look at these cards with other members of your group. Your interviewer will tell you what we would like you to do then.

Appendix 5

The Interview Guides

5a: Human Growth Hormone

Key Factors In This Probe Are :-

The transfer of genes is *between* species :
- from human to sheep
- from human to bacteria

These organisms are :
- human!
- domesticated (sheep)
- wild but cultured (bacteria)

The product is used for :
- medical reasons (treatment of HGH deficiency)
- social reasons (social advantage of tall people)

The effect on the organisms is :

a) sheep
- little effect on successfully manipulated mature sheep
- possibly disastrous effect on embryo if manipulation **unsuccessful**

b) bacteria - no apparent effect

Areas To Probe Are :-

1) is it OK to put human genes into other animals?

if **'yes'** -
a) does it matter what it's being done for?
b) what is/isn't acceptable?

if **'no'**
a) why not?
b) would it be OK to put genes from **other** living things into animals?
if **'yes'**
- what sort? - what for?

2) ask those who think it is OK to put genes into animals (whether human or other)
- would you feel differently if the animal was a hurt as result?

3) is it OK to put human genes into bacteria?
If **'yes'**
a) does it matter what it's being done for?
if 'yes'
- what is/isn't acceptable?
if **'no'**
- why not?

5b:Gene Therapy

Key Factors In This Probe Are :-

The transfer of genes is *within* species :
- from human to human

The organism is :
- human

The possible uses are :

a) somatic gene therapy (currently under research)
- only affects selected cells within one individual
- medical use only (treatment of genetic disease, cancers)

b) germ line gene therapy (currently prohibited in humans)
- alters eggs and sperm, therefore all subsequent generations
- social/medical use (eradicating genetic disease)
- social use (selecting preferred characteristics)

The effect on the organism is :
- benefit if use as treatment successful
- severe/fatal illness if treatment goes wrong
- unknown risks to embryo

Areas To Probe Are :-

1) Is it OK to use Gene Therapy on ordinary (somatic) human cells?

2) Is it OK to use Gene Therapy on human eggs/sperm?

Then check -

3) If **its not** OK for human eggs/sperm -
- Is it OK for eggs/sperm in other animals?

If '**no**'
a) how does this compare to response in HGH probe?
b) If conflict apparent, probe further....

4) If **it is** OK for human eggs/sperm
- Are there any situations when it might not be acceptable?

If '**yes**'
a) when would it not be acceptable?

Appendix 5c: The Oncomouse

Key Factors In This Probe Are :-

The transfer of genes is *within* species :
- from mouse to mouse

The organism is :
- domestic (laboratory bred mice)

The product (the 'oncomouse') is used for :
- medical research (to test the effectiveness of cancer treatments)

The effect on the organism is :
- harmful, eventually lethal

Areas To Probe Are :-

1) is it ever OK to design animals which will suffer?
   if **'no'**
   a) is it OK to design animals at all?
      if **'yes'**
      - how/what for?
      if **'no'**
      - check reasons

(* look out for contradictions with responses to HGH)

2) if **it is** OK to design animals to suffer for better cancer treatment, is it OK for other reasons?
   if **'yes'**, *probe the limits* :
   - to test cosmetics e.g. mice with sensitive skin
   - to test detergents e.g. mice with sensitive skin
   - to identify pollutants which cause illness e.g. mice which develop asthma
   - to test treatments for other diseases which are less serious than cancer e.g. mice designed to develop other diseases

3) so far we have talked about redesigning mice using mouse genes.
   - Would they feel differently if human cancer genes were being put into mice?
     If **'yes'**
     - in what way?

Appendix 5d: High Yield Crops

Key Factors In This Probe Are :-

The transfer of genes is *between* species :
- from plant species A to plant species B

These organisms are :
- wild plants
- cultivated plants

The purpose is to :
- increase food production
- non apparent

Areas To Probe Are :-

Use this sheet to probe the types of gene transfer that are, or are not, acceptable.

Use 5 categories of living thing :
humans, vertebrates (mice, sheep etc.), invertebrates (scorpions, caterpillars etc.), plants, microbes (bacteria, viruses)

Check -
* which sorts of living thing would they find it acceptable to put human genes into ?
* would it ever be acceptable to put genes from other living things into humans (if so what and for what reasons)
* is it ever be acceptable to transfer genes between any of the other groups of living things? (if so what and for what reasons)

(look for contradictions with 'scorpion venom')
* does it make any difference if the transfer involves wild things rather than things which were specially bred or domesticated or cultivated?

Examples of 'wild' - wild plants, scorpion, virus, bacteria
Examples of 'domestic' - laboratory mice, sheep, crop plants

Appendix 5e: Scorpion Venom Pesticide

Key Factors In This Probe Are :-

The transfer of genes is *between* species :
- from scorpion to virus

These organisms are :
- wild (scorpion)
- wild but cultured (virus)

The product (the genetically engineered virus) is used as :
- a pesticide (sprayed onto cabbages, infect caterpillars, venom gene becomes activated, the venom produced kills the caterpillar)

The effect on the organism is :
- non apparent
  (but note : purpose is to kill caterpillar, which is not itself genetically engineered)

Areas To Probe Are :-

This sheet is being used to look at the sort of extra information they might need in order to form an opinion. They may say that they need extra information. If they don't, ask them if they felt they needed more information. Ask them all, 'what sort of additional information would have been useful?'

Then look at the attitudes they did form on the basis of the information available :

1) is it OK to put scorpion genes into a virus?
   if '**yes**'
   a) is it OK to put other genes into viruses?
      if '**yes**'
      - what might be OK ?
      - what isn't OK?

* look for any contradictions and inconsistencies with previous answers eg
- the use of human genes in bacteria (HGH sheet)
- relative value of animals (not OK to harm mice (the oncomouse) but is OK to use techniques to kill caterpillars)

*and **probe**.*

Appendix 6

Group responses to the card sort activity

	Statement	A	D	U	C	NC
1	'When genes are taken out of animals it is very painful for them'		15			
2	'The genetic code in plants works in quite a different way to the genetic code in animals'	5	7	3	4	4
3	'Sheep that produce human insulin have a copy of the human insulin gene in every cell in their body'	1	9	5	13	1
4	'Genes are so small that you need special laboratory techniques to separate different genes'	15				
5	'Many hundreds of genes can be coded for in just one strand of DNA'	11		4	3	1

A - agree
D - disagree
U - undecided/can't agree
C - corrected by discussion with interviewer
NC - not corrected by discussion with interviewer*

* an untrained substitute interviewer had to be brought in for one group (B.1); this interviewer misunderstood the purpose of this task and failed to correct any misunderstandings about any of these statements; in addition, some groups failed to understand the correction offered by the interviewer when considering Statement 2.

Appendix 7

The range of criteria considered by students during discussion

Appendix 7a: the full range of criteria considered

1. The organism

a) the type of organism
- the relative value/importance of different organisms e.g. whether bacteria/plants are less important than sheep/dogs
- the emotional response of humans towards the organism e.g. pet or pest; affection/fear

b) the origin of the organism
- wild vs domesticated
- normal vs 'designed'

c) the precedents
- the existing relationship between that (or similar) organism and humans e.g. do we already make use of these or other organisms - in some way?- in a similar way?

d) the direction of the exchange of genes
e.g. is the exchange human to human, human to animal, animal to human etc.?

e) the effect on the organism
- amount of distress/pain it might suffer (mental and/or physical) as a result of using **or** not using the technique/product; taking into account the organism's capacity to suffer distress or pain
- possible side effects/other effects
- relative quality of life

f) other eg availability of the organism

2. The purpose

a) what for
- purpose of use e.g. medical , social, cosmetic/aesthetic, agricultural
- importance of use/severity of condition e.g. severity of the condition
- possible future uses e.g. type of use; desirability of use; possibility of misuse

b) who for (who benefits?)
- extent of use e.g. numbers involved ,
- where used eg which countries
- basis for use e.g. personal need, personal advantage, personal preference, communal benefit

3. The need

a) the need
- is it needed/ why is it needed/to what extent is it needed?

b) possible alternatives
- modification of this technique (could it be done in a different way?)

- a different technique (is an effective alternative available? If so, how do they compare?)

c) alternative causes/cures
- different cause may require different type of solution eg societal values/3rd world debt rather than destruction of crops by pests might be cause of famine, so no need for scorpion venom pesticide

4. Effectiveness

a) effectiveness
- of technique e.g. does it work/how well does it work/ is it likely to work (does it produce the goods?)?
- of use/product e.g. how well does it do what it was designed to do?; is the effect permanent?

b) available knowledge
- do we know how effective it is?

5. Risk Assessment

a) safety/risks
- how safe is the technique/product?

b) available knowledge
- do we know what the risks are? (have the risks been evaluated/researched?)
- is it possible to know what the risks are?

c) consequences : environment
- the ecosystem (general)
- the food chain
- the species eg loss of variation; extinction
- other

d) consequences: human/social
- population explosion (overcrowding, lack of food etc.) and the consequences of this
- 'contamination' : of individual; of food chain
- increased division; prejudice, tolerance (of difference), *have's* vs *have not's*
- push for perfection; rejection of less than perfect

e) consequences: other
- process effective but something else of value lost as a result
- financial

6. Control

a) need for control
- control of mechanism
- control of use

b) existence of controls

c) feasibility of control

7. Commercial aspects

a) commercial interest/profit

b) availability - is it/should it be for sale?

c) access - is it restricted to those who can pay?

8. Relative costs/benefits

a) financial e.g. appropriate use of resources

b) amount of good vs amount of harm

e.g. lives of a few mice vs lives of 1,00's of humans;

e.g. improved health due to treatment vs possibility of cell damage (leading to cancer) due to treatment

e.g. increased yield vs no harm to plant

c) social vs financial e.g. increased crop yield good for starving, bad for farmer (lower prices)

9. Personal beliefs

a) religious e.g. interferes with gods will/laws/plans/design

b) 'natural' e.g. violation of natural laws, unnatural (messing with nature/playing God)

c) established attitudes [general views, not context specific]

- people/things should be accepted for what they are (there is something wrong with a need for perfection)
- it's wrong to make animals suffer for human benefit

10. Personal circumstances

- does view change with personal circumstances/needs
  i.e. if I were affected would I feel different?

11. Moral and ethical considerations (rights and wrongs)

a) personal responsibilities

- was the problem self inflicted e.g. cancer, through smoking
- consideration for others

b) rights

- rights and wrongs (is it fair?); the need to be fair; the difficulty in being fair
- animal rights
- individual rights e.g. to give informed consent; to be loved/accepted for what you are

12. Other

a) stage of development (of the technique) - is it already possible/in use?

b) empathy - with those affected by the use e.g. the organism being used

c) egocentric - how will it affect me?

Appendix 7b: the criteria considered by individual groups

criteria	A1	A2	A3	A4	A5	A6	A7	B1	B2	C1	C2	C3	C4	C5	C6	total
1a	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	15
1b			●	●					●				●			4
1c	●	●					●		●			●		●		6
1d								●			●			●		3
1e	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	15
1f									●							1
2a	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	15
2b				●		●	●		●	●		●	●	●	●	9
3a	●	●	●		●	●	●	●	●			●		●		10
3b	●	●	●	●	●		●					●		●		8
3c					●											1
4a	●	●	●		●	●	●	●	●	●	●		●	●	●	13
4b		●												●		2
5a		●	●		●	●	●	●		●	●		●	●	●	11
5b						●	●					●	●	●	●	6
5c	●	●	●	●	●	●	●					●		●	●	10
5d	●	●		●	●	●	●	●		●		●	●	●	●	12
5e	●	●	●			●	●							●	●	7
6a	●	●	●			●	●	●			●			●		8
6b	●															1
6c	●	●	●			●	●				●			●		7
7a	●	●						●		●				●		5
7b	●	●								●						3
7c		●		●	●					●					●	5
8a		●														1
8b	●	●	●	●			●									5
8c							●									1
9a			●		●		●				●		●	●		6
9b	●	●	●		●		●		●					●	●	8
9c		●	●		●	●										4
10		●				●			●		●			●		5
11a		●								●				●		3
11b		●	●	●	●	●	●	●	●	●	●	●	●	●	●	14
12		●	●			●						●	●			5
total	17	25	18	11	15	17	20	11	12	12	11	12	12	23	13	

Appendix 8

Breakdown of Explicit Attitudes And Beliefs, by Group

	Group															
view	A1	A2	A3	A4	A5	A6	A7	B1	B2	C1	C2	C3	C4	C5	C6	total
1	●		●		●		●				●		●			6
2	●	●	●				●	●	●				●	●		9
3		●	●					●		●	●	●	●	●	●	9
4			●					●					●	●	●	5
5		●		●				●						●	●	5
6												●		●		2
7										●						1
total	2	3	4	1	1	0	2	4	1	2	2	2	4	5	3	

1. Things are as they are for a reason (so we shouldn't be trying to change them).
2. Messing with genes is wrong (acting god, messing with nature).
3. All organisms are **not** equal (in general: bacteria and plants are less important than animals and animals are less important than humans; the relative importance of different animals varied).
4. Animals should not be used/made to suffer for the benefit of humans.
5. It's only acceptable to use/change an organism if it can say what it wants/give its consent (it's wrong to choose the genes for another organism/individual).
6. If scientists can do it they will do it (along similar lines; if it is available people will miss use it).
7. Children should be loved for what they are (link with perfection).

Appendix 9

Group Response To Each Context

Group	HGH	SGT	GGT	ONCO	HYC	SVP
A1	provisional	acceptable	not acceptable	*provisional *not acceptable	provisional	unresolved
A2	unresolved	unresolved	not acceptable	provisional	-	unresolved
A3	unresolved	unresolved #		unresolved	unresolved	-
A4	provisional	-	provisional	provisional	acceptable	not acceptable
A5	*provisional *not acceptable	*provisional *not acceptable	*provisional *not acceptable	not acceptable	*not acceptable *unresolved	not acceptable
A6	provisional	provisional	unresolved	not acceptable	acceptable	not acceptable
A7	unresolved	provisional	not acceptable	provisional	provisional	unresolved
B1	provisional	provisional	not acceptable	provisional	acceptable	acceptable
B2	provisional	unresolved #		*provisional *not acceptable	*acceptable *not acceptable	acceptable
C1	provisional	provisional	unresolved	provisional	acceptable	-
C2	*provisional *not acceptable	provisional	provisional	provisional	-	-
C3	provisional	provisional	provisional	provisional	acceptable	unresolved
C4	provisional	provisional	unresolved	not acceptable	acceptable	acceptable
C5	unresolved	provisional	unresolved	not acceptable	-	not acceptable
C6	unresolved	unresolved	unresolved	unresolved	acceptable	not acceptable

Key: HGH - human growth hormone; SGT - somatic gene therapy; GGT - germ line gene therapy; ONCO - the oncomouse; HYC - high yield crops; SVP - scorpion venom pesticide

* indicates more than one view expressed within the group (no consensus)

# indicates failure to differentiate between somatic and germ line gene therapy, even with help from the interviewer

Appendix 10

Criteria Determining Final View

Appendix 10a: Unconditional Acceptance

somatic gene therapy

A1 criteria :
no justification given; once the distinction between somatic and germ line gene therapy was clear, there was no issue with somatic gene therapy

high yield crops

A4 criteria : 8b - relative costs/benefits
amount of suffering for organism vs extent of benefit to humans [it doesn't harm the plants and it provides something of benefit to humans]

A6 criteria : 8b - relative costs/benefits
amount of suffering for organism vs extent of benefit to humans [it doesn't harm the plants and it provides something of benefit to humans]

B1 criteria : 1a - type of organism
it's plants (implication: plants aren't important)
1e - effect on the organism
plants can't feel pain

B2 criteria : 1a - type of organism
it's plants, they're there (wild), they don't move, they're not living (contradicted elsewhere during interview)
2b - who's benefit
it provides something of benefit to humans

C1 criteria : 1a - type of organism
not bothered about plants (purpose secondary to this)

C3 criteria : 1e - effect on the organism
it's not cruel to plants
2b - who's benefit
it provides something of benefit to humans

C4 criteria : 1a - type of organism
it's ok (to move genes) in plants
2b - who benefits
it provides something of benefit to humans

C6 criteria : 1a - type of organism
it's not mucking about with animals

scorpion venom pesticide

B1 criteria : 1a - type of organism
not bothered about caterpillars
1f - availability of the organism to be used
there are lots of caterpillars
7a - commercial advantage

damage to the crops costs a lot of money

B2 criteria : 1a - type of organism
scorpions hurt you, insects are pests

C4 criteria : more info needed about 5c/d - risk to the environment
no justification given; once potential risks (harm through direct contact or food chain) clarified, accept it as ok

Appendix 10b: Rejection

human growth hormone

A5 criteria : 5a - how safe is the technique?
if you put human genes into other animals it might go wrong
9c - people should be accepted for what they are
people should be accepted as they are

C2 criteria : 3c - alternative causes/cures
we should look for alternatives cures (eat more)
9b - 'messing with nature'
things should be left as they are (small should stay small)

somatic gene therapy

A5 criteria : 9b - 'messing with nature'
messing with human/animal bodies is wrong

germ line gene therapy

A1 criteria : 5a - how safe is the technique?
something might go wrong, leading to mutations
6a - control of use
might be misused

A2 criteria : 5d - social consequences
11b - individual rights
not right to chose for the next generation (not even for medical reasons), something may go wrong and child might be rejected

A5 criteria : 9b - 'messing with nature'
messing with human/animal bodies is wrong

A7 criteria : 5d - effect on population
it will change the population
6c - feasibility of control
the 'slippery slope', how could you control the way it was used?
11b - individual rights (linked with 6c)
if it's ok for one thing why not another?

B1 criteria : 5a - how safe is the technique?
might go wrong and damage the child

the oncomouse

A1 criteria : 4b - do we know if it will be effective?
no cure for cancer yet, despite massive effort, what's the chance of this succeeding?

A5 criteria : 1a - type of organism *together with* 1e - effect on the organism (implication is that suffering is ok for some organisms)
unacceptable with mice
5c - possible effect on ecosystem
might interbreed with wild mice, eventually affecting all mice
9c - belief; things should be accepted as they are
you should accept things as they are

A6 criteria : 1e - effect on organism

the mouse would suffer
3b - possible alternatives
there is no need to use mice (people with cancer could be used)
4b - do we know if it will be effective?
something which is effective on mice may not be effective on humans
11b - animal/individual rights
should use people, who can give their consent

B2 criteria : 1a and 1e - type of organism and extent of suffering
it's wrong to use animals in this way, why not use humans

C4 criteria : 9b - 'messing with nature'
we don't have the right (to 'design' an animal), it's playing God
9c - personal belief; wrong to make animals suffer for the benefit of humans
it's wrong to make animals suffer for our benefit

C5 criteria : 4b - do we know if it will be effective?
what works in mice might not work in humans
11a - personal responsibilities
cancer self inflicted (smoking)

high yield crops

A5 criteria : 9b - 'messing with nature'
it's wrong to move genes about

B2 criteria : 9b - 'messing with nature'
it's messing with nature

scorpion venom pesticide

A4 criteria : 3b - consider alternatives
should consider alternatives
5c - possible effect on the environment
possible effect on the environment (food chain, loss of species)

A5 criteria : 1e - amount of suffering
of the caterpillars
3c - alternative causes and cures
caterpillars not the cause of the problem (too little food) therefore this won't solve problem; alternatives need to be considered
5c - possible effect on the environment
possible effect on the environment (food chain)

A6 criteria : 5b - is it possible to know the risks
difficulty in assessing the risks
5c - possible effect on the environment
possible effect on the environment (food chain, loss of species), possibility of cross infection (virus getting into other organisms and producing venom)

C5 criteria : 1a - type of organism
sympathy for the caterpillars

4a - how effective is it likely to be?
all caterpillars would have to be killed (this unlikely to happen), crops would still be eaten by something else
5c - effect on the food chain
it would upset the food chain

Appendix 10c: Provisional Acceptance

human growth hormone

A1	criteria :	1a - the type of organism *only ok to use sheep if alternatives not available* 1e - the amount of suffering *only ok if it doesn't cause too much suffering/pain* 2a - the purpose; the use which will be made of it *only ok for those with limited growth* 6a - the need for control *only ok to use bacteria if their use is controlled (i.e. not able to escape and infect other organisms)*
A4	criteria :	1a - the type of organism *only ok to use animals if product is for treatment of medical conditions (less bothered about bacteria)* 2a - the purpose; the use which will be made of it *ok for very short people, maybe ok for others (limited view)*
A5	criteria :	3a - the need for the product (liked to purpose/use) *ok if there is a real need (to reduce suffering)*
A6	criteria :	2a - the use which will be made of it *only acceptable for serious medical condition (not altogether sure that lack of growth hormone is serious enough), if the purpose was valid then it would be equally acceptable in sheep or bacteria*
B1	criteria :	1e - amount of suffering *only ok if the organism is not hurt* 2a - the use which will be made of it *only ok for a medical condition*
B2	criteria :	1a - type of organism *only ok if something more acceptable than bacteria or sheep could be used (they don't suggest what!)* 2a - use that will be made of it *even then, only ok for medical conditions*
C1	criteria :	2a - use that will be made of it *only ok for those with limited growth*
C2	criteria :	2a - use that will be made of it *only ok for medical condition*
C3	criteria :	2a - use that will be made of it *only ok for medical condition, if the purpose is acceptable then it's ok to use any organism (important human needs come before other organisms)*
C4	criteria :	2a - use that will be made of it *only ok for very short people (minority view: or for me if I wanted it!)*

somatic gene therapy

A5	criteria :	2a - use that will be made of it *ok for serious illness*

A6 criteria : 2a - use that will be made of it
ok for curing cystic fibrosis

A7 criteria : 2a - use that will be made of it
ok for curing illness

B1 criteria : 2a - use that will be made of it
ok for curing illness

C1 criteria : 2a - use that will be made of it
ok for curing illness

C2 criteria : 2a - use that will be made of it
ok for curing illness

C3 criteria : 2a - use that will be made of it
ok for curing illness

C4 criteria : 2a - use that will be made of it
ok for curing illness

C5 criteria : 2a - use that will be made of it
ok for curing illness
11b - individual rights
only ok if treatment optional (informed choice is important)

germ line gene therapy

A4 criteria : 2a - use that will be made of it
only ok for medical conditions, not personal preference

A5 criteria : 2a - use that will be made of it
only ok for serious medical condition (but also concerned about
6c - feasibility of control
where will it stop)

C2 criteria : 2a - use that will be made of it
only ok for medical condition
4a - effectiveness of the technique
only ok if technique effective (reliably does what it's meant to do)

C3 criteria : 2a - use that will be made of it
only ok for medical condition

the oncomouse

A1 criteria : 2a - use that will be made of it
only to development treatment for a serious medical condition (not ok for testing cosmetics or skin allergies, these unnecessary or avoidable)
3b - possible alternatives
only if no cure/effective treatment yet available (not ok for diseases like asthma, effective treatment already available)
6a - need for control
use of mice must be controlled to prevent escape and cross breeding with wild mice (might lead to spread of cancer throughout mouse population, leading to extinction)

A2 criteria : 2a - use that will be made of it

only ok for treatment for a serious medical condition
3a - possible alternatives
better to try drugs out directly on affected humans

A4 criteria :
2a - use that will be made of it
only ok for development of treatment for serious/fatal medical condition
8b - relative cost/benefits
it depends on how much testing on mice is needed (1,000's of human benefiting at the expense of a few mice may be ok, 1000's of mice for the benefit of very few humans may not be ok)

A7 criteria :
2a - use that will be made of it
only for development of treatment for a serious medical condition (not ok for unnecessary or avoidable problems)
3b - possibility of alternatives
only if no cure/effective treatment yet available (not ok for diseases like asthma, effective treatment already available) and no other means of finding a cure is available
6a - need for control
use of mice must be controlled to prevent escape and cross breeding with wild mice (might lead to spread of cancer throughout mouse population, leading to extinction)
8b - relative costs/benefits
it depends on how much testing on mice is needed (1,000's of human benefiting at the expense of a few mice may be ok, 1000's of mice for the benefit of very few humans may not be ok)

B1 criteria :
4a - how effective is it?
only ok if it will save lots of people from cancer

B2 criteria :
4a - how effective is it?
only ok if it will save lots of people from cancer
8b - relative costs/ benefits
it depends on how many mice are needed (1,000's of human benefiting at the expense of a few mice may be ok, 1000's of mice for the benefit of very few humans may not be ok)
10 - view if personally affected
recognised that they would probably feel more positive about it if they, or people close to them, were directly affected

C1 criteria :
2a - use that will be made of it
11a - personal responsibilities
ok for developing cure/treatment for serious illness if not self inflicted (smokers bring cancer on themselves so why should they be cured at the expense of the mice?)

C2 criteria :
2a - use that will be made of it
ok for developing cure/treatment for serious illness

C3 criteria :
1a - type of organism
only ok if it could be done with organisms other than animals

high yield crops

A1	criteria :	6a - need for control *only ok as long as it is contained (can't spread to other crops/plants)*
A7	criteria :	2b - for who's use? *only ok in countries with food shortages (in this country would lead to a glut and a collapse of prices for the farmer)*

Appendix 10d: Undecided

human growth hormone

A2 criteria : 2a - use that will be made of it
6c - feasibility of control
7c - access
9c - personal belief; people should be accepted for what they are

use; only OK for life threatening conditions
control; this would be difficult
access/cost; those who need it most might not be able to afford it
beliefs; people should be accepted for what they are (it's unnatural)

A3 criteria : 1d - direction of movement of genes
2a - use that will be made of it
10 - perspective if personally affected
11b - rights; if not OK for humans then should not be OK for others

purpose; maybe OK for medical reasons
but *type of organism; it's not OK to add genes to a human (not even from other humans) and in principle, what's not OK for humans is not OK for other organisms*
but *personal considerations; if personally affected they might feel differently*

A7 criteria : 2a - use that will be made of it
6c - feasibility of control
9b - messing with nature

purpose; probably OK for serious medical condition (serious growth problem)
but *control; strict control likely to be impossible and product is likely to be misused*
also *belief; we are as we are for a reason and increasing our natural height is messing with nature*

C5 criteria : 1e - amount of suffering
3a - extent of the need
6c - feasibility of control

extent of need; probably OK for those with growth problem
amount of suffering; probably OK if the sheep treated well and don't suffer too much
but *control is likely to be impossible; once it is possible to do it won't be possible to prevent it being done and once a product is available it won't be possible to restrict it's use (quote here re everything has it's price)*

C6 criteria : 2a- use that will be made of it
5a - how safe is the technique

6c - feasibility of restricting access /use

purpose/ethics; only for medical reasons (maybe OK to use animals for medical reasons but not for cosmetic reasons)

but *consequences; something may go wrong*

also *control/access; once available it won't be possible to restrict it to medical use people will find a way to buy it*

somatic gene therapy

A2 criteria : 3a - the extent of the need
5d - consequences for human population
6c - feasibility of control, once possible/available
8a - costs/benefits; is it good value for money?

use; it depends on the nature and the severity of the disease
costs/benefits; is this an appropriate use of scarce resources?
consequences; eradication of illness may lead to an increase in population and a decrease in the quality of life (jobs, housing etc.)
control; once it's possible, it may not be possible to control or restrict it's use

C6 criteria : 5a - how safe is the technique?
5d - consequences for human population

consequences; eradication of illness may lead to an increase in population and a decrease in the quality of life (jobs, housing etc.)
risks/benefits; may cure one illness but may cause others (may damage cells leading to cancer)

germ line gene therapy

A6 criteria : 2a - use that will be made of it
5d - consequences for human population
8a - costs/benefits - is it worth it?
9c - personal belief; something wrong with need for perfection

purpose; maybe OK for serious medical condition but *is it worth it? (Still have to die of something!)*

also *consequences; eradication of illness may lead to an increase in population and a decrease in the quality of life (jobs, housing etc.)*

also *belief; something wrong with a need for perfection*

C1 criteria : 1e - amount of suffering
2a - use that will be made of it

purpose; may be OK for preventing illness
suffering; OK for animals if it doesn't cause pain

C4 criteria : 2a - use that will be made of it
5a - safety of the technique

purpose; only for preventing disease
risks; something may go wrong

C5 criteria : 2a - use that will be made of it

4a - effectiveness of process
10 - view if personally affected

purpose: maybe OK for illness

also *personal circumstances; recognised that they would probably feel more positive about it if they, or people close to them, were directly affected*

but *effectiveness; depends how well it works*

* *felt they would need more information in order to reach a view*

C6 criteria : 2a - use that will be made of it
5a - safety of the technique
5d - potential effect on the population
11b - individual rights

purpose; may be OK for cystic fibrosis sufferers

but *consequences; eradication of illness may lead to an increase in population and a decrease in the quality of life (jobs, housing etc.)*
risks; something may go wrong (what's that going to do to the other genes?)
ethics; it should be optional not compulsory

***gene therapy**

(* didn't differentiate between somatic and germ line gene therapy)

A3 criteria : 2a - use that will be made of it
6c - feasibility of control
9b - 'messing with nature'

purpose; probably OK for medical reasons

but *control; were do you stop?*

also *belief; if that's the way you were born perhaps that's the way you're meant to be (changing the genes will change the essential 'you')*

B2 criteria : 2a - use that will be made of it
9b - 'messing with nature'
11b - ability to give informed consent

purpose; may be OK depending on purpose (acceptable purpose not specified)
ethics; may be more acceptable in humans than other animals as they have a choice

but *belief; it's messing with nature*

the oncomouse

A3 criteria : 1a - type of organism
1e - amount of suffering
4a - effectiveness

organism; maybe OK to use mice (most people value humans over mice)

also *suffering; maybe OK, as the oncomouse wouldn't exist at all if it wasn't going to suffer (very mixed views on this)*

but *effectiveness; can results from mice reliably inform us about effectiveness in humans?*

C6 criteria : 1a - type of organism
3a - extent of the need
4a - effectiveness
11b - animal rights

need; does it matter if some people die of cancer?
type of organism; might be better if a pest e.g. sewer rats used
ethics; animal rights; humans are more important than mice but animals should have rights too
effectiveness; how likely is it to result in a cure?

high yield crops

A3 criteria : 1d - direction of exchange of genes
9b - 'messing with nature'

organism; if genes are to be moved about then it's more OK in plants than in mice or humans
but *belief; not sure it is OK to move genes about (they are there for a purpose)*

A5 criteria : 5b - do we know what the risks are?
9b - 'messing with nature'

risk/consequences; we don't know what they are
also *beliefs; even if the risks were known, still might not be OK (messing with nature)*

scorpion venom pesticide

A1 criteria : 1d - direction of exchange
5b/5c - environmental consequences; do we know what the risks are?
6a/c - need for/feasibility of controls

organism; transfer of scorpion genes to virus might be OK
but *consequences; what are they? do we know? (Venom in the food chain? Infection of other organisms?)*
also *control; what controls could we have to prevent cross infection?*

A2 criteria : 3a - extent of need
4a - effectiveness
5e - consequences; financial
9b - 'messing with nature'

need; do we need better control of pests?
effectiveness; would it be effective in controlling pests?
consequences; it may destabilise the market - causing a glut (in the absence of pests) leading to a drop in price for the crop
belief; messing with genes is unnatural and wrong

A7 criteria : 5b/5c - environmental consequences; do we know what the risks are?

risks/consequences; what are they? do we know? (Venom in the food chain? Infection of other organisms? Long term effects)

C3 criteria : 3b - alternatives
5b/5c - environmental consequences; do we know what the risks are?

consequences; concerned about unforeseen effects on the ecosystem
alternatives; aren't there better ones?

Appendix 11

Summary Of Criteria Determining Final View, By Context

	HGH nr 17	SGT nr 13	GGT nr 14	GT nr 2	ONCO nr 17	HYC nr 14	SVP nr 12	total
1. The organism								
a) type	3				5	5	3	16
d) direction of exchange	1					1	1	3
e) effect on	3		1		3	2	1	10
f) availability							1	1
2. The purpose								
a) how used	13	9	9	2	6			39
b) who benefits						4		4
3. The need								
a) the extent	2	1			2		1	6
b) alternatives					3		2	5
c) alternative causes	1						1	2
4. The effectiveness								
a) effectiveness			2		4		2	8
b) knowledge of this					3			3
5. Risk assessment								
a) safety	2	1	4					7
b) knowledge of risk						1	4	5
possible risk :-								
c) ecosystem								
d) human/social					1		7	8
e) other		2	4					6
							1	1
6. The control								
a) the need for controls	1		1		2	1	1	6
c) feasibility of	4	1	2	1			1	9
7. Commercial aspects								
a) advantage							1	1
c) access	1							1
8. Costs/benefits								
a) value for money		1	1					2
b) mouse vs human					3			3
e) plant vs human						2		2
9. Personal beliefs								
b) not natural	2	1	1	2	1	4	1	12
c) other attitudes	2		1		2			5
10. Personal effect	1		1		1			3
11. Morals and ethics								
a) responsibilities					2			2
b) rights	1	1	3	1	2			8

Key:
HGH - human growth hormone
ONCO - the oncomouse
nr - number of responses
SGT - somatic gene therapy
GT - gene therapy
GGT - germ line gene therapy
HYC - high yield crops
SVP - scorpion venom pesticide

Note: - some groups expressed more than one view (see Appendix 9)
- some groups were unable to respond to HYC and SVP due to lack of time

Appendix 12

Summary Of Criteria Determining Final View, By Outcome

Appendix 12a: Unconditionally Accepted

	HGH nr 0/17	SGT nr 1/13	GGT nr 0/14	ONCO nr 0/17	HYC nr 8/14	SVP nr 3/12
1. The organism						
a) type					5	2
e) effect on					2	
f) availability						1
2. The purpose						
b) who benefits					3	
7. Commercial aspects						
a) advantage						1
8. Costs/benefits						
e) plant vs human					2	
none made explicit		1				1

Key: HGH - human growth hormone SGT - somatic gene therapy
GGT - germ line gene therapy ONCO - the oncomouse
HYC - high yield crops SVP - scorpion venom pesticide
nr - number of responses

Note: - some groups expressed more than one view (see Appendix)
- some groups were unable to respond to HYC and SVP due to lack of time
- several criteria may be used in determining one view

Appendix 12b: Rejected

	HGH nr 2/17	SGT nr 1/13	GGT nr 5/14	ONCO nr 6/17	HYC nr 2/14	SVP nr 5/12
1. The organism						
a) type				2		1
e) effect on				2		1
3. The need						
b) alternatives				1		1
c) alternative causes	1					1
4. The effectiveness						
a) effectiveness						1
b) knowledge of this				3		
5. Risk assessment						
a) safety	1		2			
b) knowledge of risk						1
possible risk						
c) ecosystem				1		4
d) human/social			2			
6. The control						
a) of use			1			
c) feasibility of			1			
9. Personal beliefs						
b) not natural	1	1	1	1	2	
c) other attitudes	1			2		
11. Morals and ethics						
a) responsibilities				1		
b) rights			2	1		

Key: HGH - human growth hormone SGT - somatic gene therapy
GGT - germ line gene therapy ONCO - the oncomouse
HYC - high yield crops SVP - scorpion venom pesticide
nr - number of responses

Note: - some groups expressed more than one view (see Appendix)
- some groups were unable to respond to HYC and SVP due to lack of time
- several criteria may be used in determining one view

Appendix 12c: Provisionally Accepted

	HGH nr 10/17	SGT nr 9/13	GGT nr 4/14	ONCO nr 9/17	HYC nr 2/14	SVP nr 0/12
1. The organism						
a) type	3			1		
e) effect on	2					
2. The purpose						
a) how used	9	9	4	6		
b) who benefits					1	
3. The need						
a) the extent	1			1		
b) alternatives				2		
4. The effectiveness						
a) effectiveness			1	2		
6. The control						
a) the need for control	1			2	1	
c) feasibility of			1			
8. Costs/benefits						
b) mouse vs human				3		
10. Personal effect				1		
11. Morals and ethics						
a) responsibilities				1		
b) rights		1				

Key: HGH - human growth hormone SGT - somatic gene therapy
GGT - germ line gene therapy ONCO - the oncomouse
HYC - high yield crops SVP - scorpion venom pesticide
nr - number of responses

Note: - some groups expressed more than one view (see Appendix)
- some groups were unable to respond to HYC and SVP due to lack of time
- several criteria may be used in determining one view

Appendix 12d: Undecided

	HGH nr 5/17	SGT nr 2/13	GGT nr 5/14	GT nr 2/2	ONCO nr 2/17	HYC 2/14	SVP 4/12
1. The organism							
a) type					2		
d) direction of exchange	1					1	1
e) effect on	1		1		1		
2. The purpose							
a) how used	4		5	2			
3. The need							
a) the extent	1	1			1		1
b) alternatives							1
4. The effectiveness							
a) effectiveness			1		2		1
5. Risk assessment							
a) safety	1	1	2				
b) knowledge of risk						1	3
possible risk							
c) ecosystem							3
d) human/social		2	2				
e) other							1
6. The control							
a) the need for controls							1
c) feasibility of	4	1		1			1
7. Commercial aspects							
c) access	1						
8. Costs/benefits							
a) value for money		1	1				
9. Personal beliefs							
b) not natural	1			2		2	1
c) other attitudes	1		1				
10. Personal effect	1		1				
11. Morals and ethics							
b) rights	1		1	1	1		

Key: HGH - human growth hormone SGT - somatic gene therapy
GGT - germ line gene therapy ONCO - the oncomouse
HYC - high yield crops SVP - scorpion venom pesticide
nr - number of responses

Note: - some groups expressed more than one view (see Appendix 9)
- some groups were unable to respond to HYC and SVP due to lack of time
- some groups failed to distinguish between somatic and germ line gene therapy
- several criteria may be used in determining one view

Appendix 13

Criteria Determining Final Views, By Group And Context
(note: some groups expressed more than one view)

Group A1
unconditional acceptance *(1; SGT)*
rejection *(2; GGT, ONCO)*
provisional acceptance *(3; HGH, ONCO, HYC)*
undecided *(1; SVP)*

criteria: *1a (x1), 1d(x1), 1e(x1)*
2a(x2)
3b(x1)
4b(x1)
5a(x1), 5b(x1), 5c(x1)
6a(x5), 6c(x1)

somatic gene therapy - *unconditional acceptance*
criteria : *no justification given; once the distinction between somatic and germ line gene therapy was clear, there was no issue with somatic gene therapy*

germ line gene therapy - *rejection*
criteria : 5a - how safe is the technique?
something might go wrong, leading to mutations
6a - control of use
it might be misused

the oncomouse - *rejection*
criteria : 4b - do we know if it will be effective?
no cure for cancer yet, despite massive effort, what's the chance of this succeeding?

human growth hormone - *provisional acceptance*
criteria : 1a - the type of organism
type of organism and availability of alternatives; only OK to use sheep if alternatives not available
1e - the amount of suffering
only OK if it doesn't cause too much suffering/pain
2a - the purpose; the use which will be made of it
only OK for those with limited growth
6a - the need for control
only OK to use bacteria if their use is controlled (i.e. not able to escape and infect other organisms)

the oncomouse - *provisional acceptance*
criteria : 2a - use that will be made of it
only to development treatment for a serious medical condition (not OK for testing cosmetics or skin allergies, these unnecessary or avoidable)
3b - possible alternatives

only if no cure/effective treatment yet available (not OK for diseases like asthma, effective treatment already available)

6a - need for control

use of mice must be controlled to prevent escape and cross breeding with wild mice (might lead to spread of cancer throughout mouse population, leading to extinction)

high yield crops - *provisional acceptance*

criteria : 6a - need for control

only OK as long as it is contained (can't spread to other crops/plants)

scorpion venom pesticide - *undecided*

criteria : 1d - direction of exchange

5b/5c - environmental consequences; do we know what the risks are?

6a/c - need for/feasibility of controls

organism: transfer of scorpion genes to virus might be OK

but *consequences; what are they? do we know? (Venom in the food chain? Infection of other organisms?)*

also *control; what controls could we have to prevent cross infection?*

Group A2

***rejection** (1; GGT)*
***provisional acceptance** (1; ONCO)*
***undecided** (3; HGH, SGT, SVP)*

criteria: *2a(x2)*
3a(x3)
4a(x1)
5d(x2), 5e(x1)
6c(x2)
7c(x1)
9c(x1)
11b(x1)

germ line gene therapy - *rejection*

criteria : 5d - social consequences

11b - individual rights

not right to chose for the next generation (not even for medical reasons), something may go wrong and child might be rejected

the oncomouse - *provisional acceptance*

criteria : 2a - use that will be made of it

only OK for treatment for a serious medical condition

3a - possible alternatives

better to try drugs out directly on affected humans

human growth hormone - *undecided*

criteria : 2a - use that will be made of it

6c - feasibility of control

7c - access

9c - personal belief; people should be accepted for what they are

use: only OK for life threatening conditions

control: this would be difficult
access/cost: those who need it most might not be able to afford it
beliefs: people should be accepted for what they are (it's unnatural)

somatic gene therapy - *undecided*

criteria : 3a - the extent of the need
5d - consequences for human population
6c - feasibility of control, once possible/available
8a - costs/benefits; is it good value for money?

use: it depends on the nature and the severity of the disease
costs/benefits: is this an appropriate use of scarce resources?
consequences: eradication of illness may lead to an increase in population and a decrease in the quality of life (jobs, housing etc.)
control: once it's possible, it may not be possible to control or restrict it's use

scorpion venom pesticide - *undecided*

criteria : 3a - extent of need
4a - effectiveness
5e - consequences; financial
9b - 'messing with nature'

need: do we need better control of pests?
effectiveness: would it be effective in controlling pests?
consequences: it may destabilise the market - causing a glut (in the absence of pests) leading to a drop in price for the crop
belief: messing with genes is unnatural and wrong

Group A3

***undecided** (4HGH, *GT, ONCO, HYC)*

** no distinction made between germ line and somatic gene therapy*

criteria: *1a(x1), 1d(x2), 1e(x1)*
2a(x2)
4a(x1)
6c(x1)
9b(x2)
11b(x1)

human growth hormone - *undecided*

criteria : 1d - direction of movement of genes
2a - use that will be made of it
10 - perspective if personally affected
11b - rights; if not OK for humans then should not be OK for others

purpose: maybe OK for medical reasons

but *type of organism: it's not OK to add genes to a human (not even from other humans) and in principle, what's not OK for humans is not OK for other organisms*

but *personal considerations: if personally affected they might feel differently*

gene therapy - *undecided

criteria : 2a - use that will be made of it
6c - feasibility of control

9b - 'messing with nature'

purpose; probably OK for medical reasons

but *control; were do you stop?*

also *belief; if that's the way you were born perhaps that's the way you're meant to be (changing the genes will change the essential 'you')*

the oncomouse - *undecided*

criteria : 1a - type of organism
1e - amount of suffering
4a - effectiveness

organism; maybe OK to use mice (most people value humans over mice)

also *suffering; maybe OK, as the oncomouse wouldn't exist at all if it wasn't going to suffer (very mixed views on this)*

but *effectiveness; can results from mice reliably inform us about effectiveness in humans?*

high yield crops - *undecided*

criteria : 1d - direction of exchange of genes
9b - 'messing with nature'

organism; if genes are to be moved about then it's more OK in plants than in mice or humans

but *belief; not sure it is OK to move genes about (they are there for a purpose)*

Group A4

***unconditional acceptance** (1; HYC)*
***rejection** (1; SVP)*
***provisional acceptance** (3; HGH, GGT, ONCO)*

criteria: *1a(x1)*
2a(x3)
3b(x1)
5c(x1)
8b(x2)

high yield crops - *unconditional acceptance*

criteria : 8b - relative costs/benefits (combined
amount of suffering for organism vs extent of benefit to humans
[it doesn't harm the plants and it provides something of benefit to humans]

scorpion venom pesticide - *rejection*

criteria : 3b - consider alternatives
should consider alternatives
5c - possible effect on the environment
possible effect on the environment (food chain, loss of species)

human growth hormone - *provisional acceptance*

criteria : 1a - the type of organism
only OK to use animals if product is for treatment of medical conditions (less bothered about bacteria)

2a - the purpose; the use which will be made of it
OK for very short people, maybe OK for others (limited view)

germ line gene therapy - *provisional acceptance*

criteria : 2a - use that will be made of it
only OK for medical conditions, not personal preference

the oncomouse - *provisional acceptance*

criteria : 2a - use that will be made of it
only OK for development of treatment for serious/fatal medical condition
8b - relative cost/benefits
[it depends on how much testing on mice is needed (1,000's of human benefiting at the expense of a few mice may be OK, 1000's of mice for the benefit of very few humans may not be OK)]

Group A5

rejection *(6; HGH, GGT, SGT, ONCO, HYC, SVP)*
provisional acceptance *(3; HGH, SGT, GGT)*
undecided *(1; HYC)*

criteria: *1a(x1), 1e(x1)*
2a(x2)
3a(x1), 3c(x1)
5a(x1), 5b(x1), 5c(x2)
6c(x1)
9b(x4), 9c(2)

note: with the exception of SVP, there is a moral/belief element to all rejected applications

human growth hormone - *rejection*

criteria : 5a - how safe is the technique?
if you put human genes into other animals it might go wrong
9c - people should be accepted for what they are
people should be accepted as they are

germ line gene therapy - *rejection*

criteria : 9b - 'messing with nature'
messing with human/animal bodies is wrong

somatic gene therapy - *rejection*

criteria : 9b - 'messing with nature'
messing with human/animal bodies is wrong

the oncomouse - *rejection*

criteria : 1a/1e - type of organism *together with* effect on the organism (implication is that suffering is OK for some organisms)
unacceptable with mice
5c - possible effect on ecosystem
might interbreed with wild mice, eventually affecting all mice
9c - belief; things should be accepted as they are

you should accept things as they are

high yield crops - *rejection*

criteria : 9b - 'messing with nature'

it's wrong to move genes about

scorpion venom pesticide - *rejection*

criteria : 1e - amount of suffering

of the caterpillars

3c - alternative causes and cures

caterpillars not the cause of the problem (too little food) therefore this won't solve problem; alternatives need to be considered

5c - possible effect on the environment

possible effect on the environment (food chain)

human growth hormone - *provisional acceptance*

criteria : 3a - the need for the product (linked to purpose/use)

OK if there is a real need (to reduce suffering)

somatic gene therapy - *provisional acceptance*

criteria : 2a - use that will be made of it

OK for serious illness

germ line gene therapy - *provisional acceptance*

criteria : 2a - use that will be made of it

only OK for serious medical condition

6c - feasibility of control

but *also concerned about control: where will it stop?*

undecided

high yield crops - *undecided*

criteria : 5b - do we know what the risks are?

9b - 'messing with nature'

risk/consequences; we don't know what they are

also *beliefs; even if the risks were known, still might not be OK (messing with nature)*

Group A6

unconditional acceptance *(1; HYC)*

rejection *(2; ONCO, SVP)*

provisional acceptance *(2; HGH, SGT)*

undecided *(1; GGT)*

criteria: *1e(x1)*

2a(x3)

3b(x1)

4b(x1)

5b(x1), 5c(x1), 5d(x1)

8b(x1)

9c(x1)

11b(x1)

high yield crops - *unconditional acceptance*

criteria : 8b - relative costs/benefits
amount of suffering for organism vs extent of benefit to humans
[it doesn't harm the plants and it provides something of benefit to humans]

the oncomouse - *rejection*

criteria : 1e - effect on organism
the mouse would suffer
3b - possible alternatives
there is no need to use mice (people with cancer could be used)
4b - do we know if it will be effective?
something which is effective on mice may not be effective on humans
11b - animal/individual rights
we should use people, who can give their consent

scorpion venom pesticide - *rejection*

criteria : 5b - is it possible to know the risks
difficulty in assessing the risks
5c - possible effect on the environment
possible effect on the environment (food chain, loss of species), possibility of cross infection (virus getting into other organisms and producing venom)

human growth hormone - *provisional acceptance*

criteria : 2a - the use which will be made of it
only acceptable for serious medical condition (not altogether sure that lack of growth hormone is serious enough), if the purpose was valid then it would be equally acceptable in sheep or bacteria

somatic gene therapy - *provisional acceptance*

criteria : 2a - use that will be made of it
OK for curing cystic fibrosis

germ line gene therapy - *undecided*

criteria : 2a - use that will be made of it
5d - consequences for human population
8a - costs/benefits - is it worth it?
9c - personal belief; something wrong with need for perfection

purpose; maybe OK for serious medical condition but *is it worth it? (Still have to die of something!)*

also *consequences; eradication of illness may lead to an increase in population and a decrease in the quality of life (jobs, housing etc.)*

also *belief; something wrong with a need for perfection*

Group A7

rejection (1; GGT)
provisional acceptance (3; SGT, ONCO, HYC)
undecided (2; HGH, SVP)

criteria: *2a(x3), 2b(x1)*
3b(x1)

5b(x1), 5c(x1), 5d(x1)
6a(x1), 6c(x2)
8b(1)
9b(x1)
11b(x1)

germ line gene therapy - *rejection*
criteria : 5d - effect on population
it will change the population
6c - feasibility of control
the 'slippery slope', how could you control the way it was used?
11b - individual rights (linked with 6c)
if it's OK for one thing why not another?

somatic gene therapy - *provisional acceptance*
criteria : 2a - use that will be made of it
OK for curing illness

the oncomouse - *provisional acceptance*
criteria : 2a - use that will be made of it
only for development of treatment for a serious medical condition (not OK for unnecessary or avoidable problems)
3b - possibility of alternatives
only if no cure/effective treatment yet available (not OK for diseases like asthma, effective treatment already available) and no other means of finding a cure is available
6a - need for control
use of mice must be controlled to prevent escape and cross breeding with wild mice (might lead to spread of cancer throughout mouse population, leading to extinction)
8b - relative costs/benefits
[it depends on how much testing on mice is needed (1,000's of human benefiting at the expense of a few mice may be OK, 1000's of mice for the benefit of very few humans may not be OK)]

high yield crops - *provisional acceptance*
criteria : 2b - for who's use?
only OK in countries with food shortages (in this country would lead to a glut and a collapse of prices for the farmer)

human growth hormone - *undecided*
criteria : 2a - use that will be made of it
6c - feasibility of control
9b - messing with nature
purpose; probably OK for serious medical condition (serious growth problem)
but *control; strict control likely to be impossible and product is likely to be misused*
also *belief: we are as we are for a reason and increasing our natural height is messing with nature*

scorpion venom pesticide - *undecided*
criteria : 5b/5c - environmental consequences; do we know what the risks are?

risks/consequences; what are they? do we know? (Venom in the food chain? Infection of other organisms? Long term effects)

Group B1

unconditional acceptance (2;HYC, SVP)
rejection (1; GGT)
provisional acceptance (3; HGH, SGT, ONCO)

criteria: *1a(x2), 1e(x1), 1f(x1)*
2a(x2)
4a(x1)
5a(x1)

note; fewer and different to many others; does this relate to other aspects of this group (reluctance to engage, inability to stay on task, disruption form some members of the group?)

high yield crops - *unconditional acceptance*
criteria : 1a - type of organism
it's plants (implication: plants aren't important)
1e - effect on the organism
plants can't feel pain

scorpion venom pesticide - *unconditional acceptance*
criteria : 1a - type of organism
(not bothered about caterpillars)
1f - availability of the organism to be used
(there are lots of caterpillars)
7a - commercial advantage
(damage to the crops costs a lot of money)

germ line gene therapy - *rejection*
criteria : 5a - how safe is the technique?
might go wrong and damage the child

human growth hormone - *provisional acceptance*
criteria : 1e - amount of suffering
only OK if the organism is not hurt
2a - the use which will be made of it
only OK for a medical condition

somatic gene therapy - *provisional acceptance*
criteria : 2a - use that will be made of it
OK for curing illness

the oncomouse - *provisional acceptance*
criteria : 4a - how effective is it?
only OK if it will save lots of people from cancer

Group B2

unconditional acceptance *(2; HYC, SVP)*

rejection *(2; ONCO, HYC)*
provisional acceptance *(2; HYC, ONCO)*
undecided *(1; *GT)*
** no distinction made between germ line and somatic gene therapy*

criteria: *1a(x4), 1e(x1)*
2a(x2), 2b(x1)
4a(x1)
8b(x1)
9b(x2)
10(x1)
11b(x1)

high yield crops - *unconditional acceptance*
criteria : 1a - type of organism
it's plants, they're there (wild), they don't move, they're not living (contradicted elsewhere during interview)
2b - who's benefit
it provides something of benefit to humans

scorpion venom pesticide - *unconditional acceptance*
criteria : 1a - type of organism
scorpions hurt you, insects are pests

the oncomouse - *rejection*
criteria : 1a and 1e - type of organism and extent of suffering
it's wrong to use animals in this way, why not use humans

high yield crops - *rejection*
criteria : 9b - 'messing with nature'
it's messing with nature

human growth hormone - *provisional acceptance*
criteria : 1a - type of organism
only OK if something more acceptable than bacteria or sheep could be used (they don't suggest what!)
2a - use that will be made of it
even then, only OK for medical conditions

the oncomouse - *provisional acceptance*
criteria : 4a - how effective is it?
only OK if it will save lots of people from cancer
8b - relative costs/ benefits
[it depends on how much testing on mice is needed (1,000's of human benefiting at the expense of a few mice may be OK, 1000's of mice for the benefit of very few humans may not be OK)]
10 - view if personally affected
recognised that they would probably feel more positive about it if they, or people close to them, were directly affected

gene therapy - *undecided*
criteria : 2a - use that will be made of it
9b - 'messing with nature'
11b - ability to give informed consent

purpose: may be OK depending on purpose (acceptable purpose not specified)
ethics: may be more acceptable in humans than other animals as they have a choice

but *belief: it's messing with nature*

Group C1

unconditional acceptance (1; HYC)
provisional acceptance (3; HGH, SGT, ONCO)
undecided (1; GGT)

criteria: *1a(x1), 1e(x1)*
2a(x4)
11a(x1)

high yield crops - *unconditional acceptance*
criteria : 1a - type of organism
not bothered about plants (purpose secondary to this)

human growth hormone - *provisional acceptance*
criteria : 2a - use that will be made of it
only OK for those with limited growth

somatic gene therapy - *provisional acceptance*
criteria : 2a - use that will be made of it
OK for curing illness

the oncomouse - *provisional acceptance*
criteria : 2a - use that will be made of it
11a - personal responsibilities
*OK for developing cure/treatment for serious illness **if** not self inflicted (smokers bring cancer on themselves so why should they be cured at the expense of the mice?)*

germ line gene therapy - *undecided*
criteria : 1e - amount of suffering
2a - use that will be made of it
purpose: may be OK for preventing illness
suffering: OK for animals if it doesn't cause pain

Group C2

rejection (1; HGH)
provisional acceptance (4; HGH, SGT, GGT, ONCO)

criteria: *2a(x4)*
3c(x1)
4a(x1)
9b(x1)

human growth hormone - *rejection*
criteria : 3c - alternative causes/cures
we should look for alternatives cures (eat more)
9b - 'messing with nature'
things should be left as they are (small should stay small)
human growth hormone - *provisional acceptance*
criteria : 2a - use that will be made of it
only OK for medical condition
somatic gene therapy - *provisional acceptance*
criteria : 2a - use that will be made of it
OK for curing illness
germ line gene therapy - *provisional acceptance*
criteria : 2a - use that will be made of it
only OK for medical condition
4a - effectiveness of the technique
only OK if technique effective (reliably does what it's meant to do)
the oncomouse - *provisional acceptance*
criteria : 2a - use that will be made of it
OK for developing cure/treatment for serious illness

<u>Group C3</u>
unconditional acceptance (1; HYC)
provisional acceptance (4; HGH, SGT, GGT, ONCO)
undecided (1; SVP)

criteria: *1a(x1), 1e(x1)*
2a(x3), 2b(x1)
3b(x1)
5b(x1), 5c(x1)

high yield crops - *unconditional acceptance*
criteria : 1e - effect on the organism
it's not cruel to plants
2b - who's benefit
it provides something of benefit to humans
human growth hormone - *provisional acceptance*
criteria : 2a - use that will be made of it
only OK for medical condition, if the purpose is acceptable then it's OK to use any organism (important human needs come before other organisms)
somatic gene therapy - *provisional acceptance*
criteria : 2a - use that will be made of it
OK for curing illness
germ line gene therapy - *provisional acceptance*
criteria : 2a - use that will be made of it
only OK for medical condition

the oncomouse - *provisional acceptance*

criteria : 1a - type of organism

only OK if it could be done with organisms other than animals

scorpion venom pesticide - *undecided*

criteria : 3b - alternatives

5b/5c - environmental consequences; do we know what the risks are?

consequences; concerned about unforeseen effects on the ecosystem

alternatives; aren't there better ones?

Group C4

unconditional acceptance (2; HYC, SVP)
rejection (1; ONCO)
provisional acceptance (2; HGH, SGT)
undecided (1; GGT)

criteria: *1a(x1)*
2a(x3), 2b(x1)
5a(x1), 5c(x1), 5d(x1)
9b(x1), 9c(x1)

high yield crops - *unconditional acceptance*

criteria : 1a - type of organism

it's OK (to move genes) in plants

2b - who benefits

it provides something of benefit to humans

scorpion venom pesticide - *unconditional acceptance*

criteria : more information needed about 5c/d - risk to the environment

no justification given; once potential risks (harm through direct contact or food chain) clarified, accept it as OK

the oncomouse - *rejection*

criteria : 9b - 'messing with nature'

we don't have the right (to 'design' an animal), it's playing God

9c - personal belief; wrong to make animals suffer for the benefit of humans

it's wrong to make animals suffer for our benefit

human growth hormone - *provisional acceptance*

criteria : 2a - use that will be made of it

only OK for very short people (minority view: or for me if I wanted it!)

somatic gene therapy - *provisional acceptance*

criteria : 2a - use that will be made of it

OK for curing illness

germ line gene therapy - *undecided*

criteria : 2a - use that will be made of it

5a - safety of the technique

purpose; only for preventing disease

risks; something may go wrong

Group C5
rejection (2; ONCO, SVP)
provisional acceptance (1; SGT)
undecided (2; HGH, GGT)

criteria: *1a(x1), 1e(x1)*
2a(x2)
3a(x1)
4a(x2), 4b(x1)
5c(x1)
6c(x1)
10(x1)
11a(x1), 11b(x1)

the oncomouse - *rejection*
criteria : 4b - do we know if it will be effective?
what works in mice might not work in humans
11a - personal responsibilities
cancer self inflicted (smoking)

scorpion venom pesticide - *rejection*
criteria : 1a - type of organism
sympathy for the caterpillars
4a - how effective is it likely to be?
all caterpillars would have to be killed (this unlikely to happen), crops would still be eaten by something else
5c - effect on the food chain
it would upset the food chain

somatic gene therapy - *provisional acceptance*
criteria : 2a - use that will be made of it
OK for curing illness
11b - individual rights
only OK if treatment optional (informed choice is important)

human growth hormone - *undecided*
criteria : 1e - amount of suffering
3a - extent of the need
6c - feasibility of control
extent of need; probably OK for those with growth problem
amount of suffering; probably OK if the sheep treated well and don't suffer too much
but *control is likely to be impossible; once it is possible to do it won't be possible to prevent it being done and once a product is available it won't be possible to restrict it's use (quote here re everything has it's price)*

germ line gene therapy - *undecided*
criteria : 2a - use that will be made of it
4a - effectiveness of process
10 - view if personally affected
purpose; maybe OK for illness

also *personal circumstances; recognised that they would probably feel more positive about it if they, or people close to them, were directly affected*

but *effectiveness; depends how well it works*

* *the group felt they would need more information in order to reach a view*

Group C6

unconditional acceptance (1; HYC)
rejection (1; SVP)
undecided (4; HGH, SGT, GGT, ONCO)

criteria: *1a(x2)*
2a(x2)
3a(x1)
4a(x1)
5a(x3), 5c(x1), 5d(x2)
6c(x1)
11b(x2)

scorpion venom pesticide - *rejection*

criteria : 5c - effect on the food chain
it would upset the food chain

high yield crops - *unconditional acceptance*

criteria : 1a - type of organism
it's not mucking about with animals

human growth hormone - *undecided*

criteria : 2a- use that will be made of it
5a - how safe is the technique
6c - feasibility of restricting access /use

purpose/ethics; only for medical reasons (maybe OK to use animals for medical reasons but not for cosmetic reasons)

but *consequences; something may go wrong*

also *control/access; once available it won't be possible to restrict it to medical use people will find a way to buy it*

somatic gene therapy - *undecided*

criteria : 5a - how safe is the technique?
5d - consequences for human population

consequences; eradication of illness may lead to an increase in population and a decrease in the quality of life (jobs, housing etc.)

risks/benefits; may cure one illness but may cause others (may damage cells leading to cancer)

germ line gene therapy - *undecided*

criteria : 2a - use that will be made of it
5a - safety of the technique
5d - potential effect on the population
11b - individual rights

purpose; may be OK for cystic fibrosis sufferers

but *consequences; eradication of illness may lead to an increase in population and a decrease in the quality of life (jobs, housing etc.)*
risks; something may go wrong (what's that going to do to the other genes?))
ethics; it should be optional not compulsory

the oncomouse - *undecided*

criteria : 1a - type of organism
3a - extent of the need
4a - effectiveness
11b - animal rights

need; does it matter if some people die of cancer?
type of organism; might be better if a pest e.g. sewer rats used
ethics; animal rights; humans are more important than mice but animals should have rights too
effectiveness; how likely is it to result in a cure?

Appendix 14

Summary Of Criteria Determining Final View, By Group

	A1	A2	A3	A4	A5	A6	A7	B1	B2	C1	C2	C3	C4	C5	C6
1. The organism															
a) type	1		1	1	1			2	4	1		1	1	1	2
d) direction of exchange	1		2												
e) effect on	1		1		1	1		2	1	1		1		1	
f) availability								1							
2. The purpose															
a) how used	2	2	2	3	2	3	3	2	2	4	4	3	3	2	2
b) who benefits							1		1			1	1		
3. The need															
a) the extent		3			1									1	1
b) alternatives	1			1		1	1					1			
c) alternative causes					1						1				
4. The effectiveness															
a) effectiveness		1	1					1	1		1			2	1
b) knowledge of this	1					1								1	
5. Risk assessment															
a) safety	1				1			1					1		3
b) knowledge of risk	1				1	1	1					1			
possible risk															
c) ecosystem	1			1	2	1	1					1		1	1
d) human/social		2				1	1								2
e) other		1													
6. The control															
a) the need for controls	5						1								
c) feasibility of	1	2	1		1		2							1	1
7. Commercial aspects															
a) advantage								1							
c) access		1													
8. Costs/benefits															
a) value for money		1				1									
b) relative suffering/				2		1	1		1						
relative benefit															
9. Personal beliefs															
b) not natural		1	2		3		1		2		1	1	1		
c) other attitudes		1			2	1							1		
10. Personal effect			1						1					1	
11. Morals and ethics															
a) responsibilities										1				1	
b) rights		1	1			1	1		1					1	2