



science and technology

Department:  
Science and Technology  
REPUBLIC OF SOUTH AFRICA



## **HSRC client survey 2004**

**Report to**

**Public Understanding of Biotechnology**

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## **Background**

Although a number of surveys have been undertaken in South Africa to measure public perceptions, attitudes and levels of understanding on specific controversial biotechnology topics such as GM foods, cloning and stem cell research, none have covered biotechnology as a whole. Further limitations have included the use of small sample sizes, which are not demographically representative, which limits the accuracy of the results (see [www.pub.ac.za](http://www.pub.ac.za) for list of other surveys undertaken). Questions included in these surveys have also not always enabled comparisons with data generated from similar work undertaken elsewhere in the world, and have also included mostly quantitative data sets only.

The Human Sciences Research Council (HSRC) is one of a few (publicly funded) research organizations in South Africa equipped to tackle this issue in partnership with the Public Understanding of Biotechnology (PUB) funded by the Department of Science and Technology. The survey results will ultimately not only provide a snapshot of the current situation, but also provide a baseline to be used for comparisons to future repeats of the similar surveys. In addition, the results will provide guidance in developing an optimum communications strategy for the PUB programme, especially in the area of specific knowledge gaps and information needs, which will be followed up with further investigations by means of focal groups (qualitative research). While this PUB/HSRC survey does not claim to be faultless, it is recognised that this is the first step towards building a comprehensive, reliable data set on biotechnology public opinion in South Africa.

## **The Sample**

The sample was drawn from the Human Sciences Research Council's Master Sample, which is a sampling frame that consists of 1000 census enumerator areas (EAs). Enumerated areas are geographical boundaries that were created by Stats SA for the census studies. The 1000 EAs were chosen in such a way that it is representative of South Africa. The EAs chosen from the census sample frame were stratified by the socio-demographic domains of province, geographical sub-type and the four population groups. The 1000 EAs were photographed from the air and maps were produced for all of these areas. These maps were then loaded onto a Geographical Information Systems (GIS) package and each of the EAs was divided into a series of visiting points. Different types of areas defined primarily by the dominant dwelling type, population group and location in urban versus rural localities are thus used by this master sample to ensure that respondents from different types of communities throughout the country are selected for the survey.

For the purpose of this study, 500 of the 1000 EAs were selected and 14 people visited per EA. This survey was thus designed to yield a representative sample of 7000 adults aged 16 and older (with no upper age limit), regardless of their nationality or citizenship, in households geographically spread across the country's nine provinces. The sample was thus designed in such a way that it is representative of the total adult (16 years and older) population of South Africa and when weighted represents 29 446 688 adults.

Slightly less than half of the respondents (46%) were male and the rest (54%) were female. A total of 76% of the respondents were African/Black, 12% were white, 9% were coloured and 3% were Asian. In terms of age distribution, 29% were 16-20 years, 24% were 21-25 years, 26% were 26-60 years and 20% were 60 years and older. The majority, 53% were interviewed in urban formal areas, 35% in tribal areas and 9% in urban informal areas and 4% in rural formal.

### Realisation of Survey

	Frequency	Percent	Valid Percent	Cumulative Percent
Completed questionnaire	5639	82.2	82.2	82.2
Partially completed	46	.7	.7	82.9
Appointment made	1	.0	.0	82.9
Selected respondent not at home	8	.1	.1	83.0
No one home	298	4.3	4.3	87.4
Vacant house/flat/stand/not house/flat	225	3.3	3.3	90.6
No person qualifies according to survey	11	.2	.2	90.8
Respondent cannot communicate-language	5	.1	.1	90.9
Respondent physically/mentally not fit	12	.2	.2	91.0
Contact person refused	579	8.4	8.4	99.5
Refused by selected respondent	11	.2	.2	99.7
Interview refused by parent	1	.0	.0	99.7
Interview refused by other hh member	16	.2	.2	99.9
EA saturated	7	.1	.1	100.0
Total	6859	100.0	100.0	

## **SECTION 1:**

### **Public Understanding of Biotechnology**

Survey respondents were asked a question, how often, apart from the brand name, they read information on food labels. It emerged that a little over half (51%) of respondents seldom or never read the information on food labels. However, nearly a quarter (23%) often or always read the information on food labels. Just over a quarter (27%) sometimes read the information on food labels.

Just over a third within the higher LSM group (37%) often or always read information on food labels, as opposed to just over two-fifths (21%) within the moderate LSM group. Only one tenth within the lower LSM group read the information. Therefore, reading information on food labels seems to be a preoccupation among higher than lower LSM groups.

Respondents were also asked about the types of information they would like to see on food labels:

Just over a fifth (21%) of respondents indicated that they would like to see more information on ingredients and an equal proportion indicated that they would like to see information on health benefits on food labels. However, a slightly bigger proportion (22%) of respondents did not know what they would like to see displayed on food labels.

### **What do you think of when you hear the word Biotechnology?**

Eight out of ten (82%) of individuals did not know what they thought when they heard the word 'biotechnology'. The rest of the individuals had quite varied responses, ranging from positive thoughts like "What people put in vegetables to make them grow quicker", or 'changes cells and plants to grow better' to negative like: 'genetic manipulation of food' or 'intervene with God's work'. However, some would take the prefix 'bio' or the suffix 'technology' and then describe their thoughts. For example, one respondent said: 'combination of two things' and yet another said: "technology involves living things". Others made other comparisons outside the term 'biotechnology' itself; respondent said: 'cell phones' or 'course offered at university'. (For a complete list see Appendix A).

### **Is this thought about biotechnology negative or positive?**

More than two-thirds of respondents (68%) did not know whether they had positive or negative thoughts about biotechnology. However, nearly a fifth (19%) had either positive or very positive thoughts about biotechnology, compared to less than a tenth (7%) who either had negative or very negative thoughts about biotechnology.

### **What do you think when you hear the word genetic engineering?**

Again, a little more than 8 out of 10 individuals (86%) did not know what they thought when they heard the word 'genetic engineering'. Amongst the 14% who did have thoughts on the topic, there were a wide variety of responses ranging from "I think

about cloning”, ‘research in genetic genes’ or “ Like Molly (Dolly) the sheep and plants” Some spoke of the outcomes like: “ food for more people” or ‘converting plants’, or ‘improvement of colour on certain foods e.g. apples and tomatoes.” (For a complete list see Appendix B).

### **Is this thought genetic engineering negative or positive?**

An overwhelming majority (80%) did not know whether their thought about ‘genetic engineering’ was positive or negative. Only slightly about one is seven (14%) of all respondents thought that ‘genetic engineering’ had positive or very positive connotations. However, this was slightly better than the 9% of respondents who had negative or very negative connotations of the word ‘genetic engineering’.

### **What do you think when you hear the word genetic modification?**

Nearly nine out of ten individuals (88%) did not know what they thought when they heard the word ‘genetic modification’. Of the remaining 12%, a wide variety of interpretations prevailed. The responses ranged from scientifically correct or descriptive explanations (e.g. ‘modifying food for many people’, ‘changing of genes’ and ‘plants and maize manipulate...’ “scientific chemicals to grow food”) to positive depictions (e.g. ‘make products taste good’, “ genes to improve environment” and “making plants grow faster” ). The more negative connotations had either a moral or emotional flavor as in “sins”, “I think about my feelings” or “modify God’s work” and “ play with genes”. (For a complete list see Appendix C).

### **Is this thought of genetic modification negative or positive?**

Just under three-quarters (73%) of respondents did not know whether the thought about genetic modification was either positive or negative. However, just over a tenth (11%) of the respondents were either positive or very positive, compared to exactly a tenth (10%) who were either negative or very negative. Six percent were neither too positive nor too negative.

### **What do you think when you hear the word cloning?**

A little more than eight out of ten (83%) individuals did not know what they thought when they heard the word ‘cloning’. Of the remaining responses, there was a wide range of answers. These ranged from scientifically correct responses like: “something to do with DNA”, to “it is a copy that is exactly the same”, or “artificial reproduction of life” and “making replicas of individuals by cloning DNA cells”, or simply: “splitting of cells”; to popular figures associated with cloning like: “Molly/ Dolly the sheep”, and science fiction as in: “Monster humans without souls” or “clone a cow and make another human being”. There were also positive associations as in: “creating new genes” and distinctions made about the different types of cloning as in: “therapeutic cloning is fine-cure, reproductive cloning is not.” Again, the word seemed to evoke moral outrage as in: “getting involved in God’s responsibility,” or “Unnatural” and “dangerous”. (For a complete list see Appendix D).

### Is this thought of cloning negative or positive?

Just a little over two-thirds (69%) of respondents did not know whether cloning was negative or positive. However, nearly a fifth (19%) of respondents were either negative or very negative compared to just under a tenth (7%) that thought that genetic cloning was either positive or very positive. The remaining 6% were equivocal, neither saying cloning was neither positive nor saying cloning was negative.

### Of the following list of new technologies that are currently developing, please say whether you think they will improve, worsen or have no effect on our way of life in the next 20 years?

**Table 1:**

	Improve	No Effect	Worse	Don't know
Solar energy	57	11	4	28
Computers & information technology	82	3	1	13
Biotechnology/Genetic engineering	24	7	4	65
Nanotechnology	16	7	2	<b>74</b>
Space exploration	33	<b>12</b>	5	50
Nuclear energy	35	10	<b>6</b>	50
Mobile phones/cell phones	<b>87</b>	2	2	9

Table 1 above shows that a little more than eight out of ten respondents (87%) listed mobile phones or cell phones as new technologies that will improve our way of life in the next 20 years. These technologies are closely followed by computers and information technology (82%) as the second most likely to effect improvement in our way of life 20 years hence. Nearly three-quarters (74%) did not know whether nanotechnology will improve, worsen or have any effect on our way of life in the next 20 years. Slightly more than a tenth (12%) felt that space exploration will have no effect at all on our way of life in the next 20 years. Also, there were few respondents who tended to think that these newer technologies will worsen our way of life in the next 20 years, 6% being the highest on the nuclear energy technology as having potentially the worst effect on our way of life in the next 20 years.

Very few respondents felt that all the technologies listed will not have any effect at all our way of life in the next 20 years.

### As far as you know, have you eaten any food containing GM (genetically modified) ingredients?

Just over three-fifths (63%) of respondents did not know whether they had ever eaten any food containing GM ingredients. Just over a quarter (26%) of respondents answered 'no' to the question of whether they recall ever eating any food containing GM. Only a little more than a tenth (12%) of respondents answered in the affirmative when asked whether they had ever eaten any food containing GM.

**Can you name any foods containing GM ingredients on sale in shops or supermarkets in South Africa? If yes, please specify which foods.**

**TABLE 2:**

<b>Foods</b>	<b>% of Responses</b>	<b>% of Cases</b>
Apples	3	4
Canola	0	1
Carrot	2	2
Cereal	1	1
Cooking Oil	1	2
Maize	4	5
Fruits	3	4
Lettuce	1	1
Meats/poultry-general	2	3
Milk/dairy/cheese/yoghurt/eggs	3	4
Potato	2	2
Processed foods	2	2
Soy Beans	1	1
Tomatoes	3	4
Vegetables-general	3	4
Rice	0	1
Taco shells	0	0
Other foods	2	2
Everything	1	1
Not asked question	1	1
Don't know or no answer	66	80

Table 2 shows that two-thirds of responses (66%) were 'don't know' responses. For those respondents who named any foods containing GM ingredients, most responses were for maize, apples, milk and dairy products, tomatoes, and fruits and vegetables in general.

**Factual knowledge:**

Respondents were requested to respond to a number of statements and state whether these were true or not. These were the statements and responses:

**Graph 1:**

In graph Graph 1 it becomes clear that most respondents were not able to verify the truth of the statements. However, this tendency was particularly acute in the last statement: "It is possible to put animal genes into plants", with three-fifths (62%) of respondents indicating that they did not know. A higher proportion of respondents, nearly a quarter (24%) answered 'No' to the statement.

Just under two-fifths (38%) of respondents were affirmative to the statement: "It is possible to find out in the first few months of pregnancy whether a child will have Down's Syndrome or not.". There was a higher proportion of 'true' responses to this than to any other statement.

**Attitudes and Judgments:**

**Respondents were given the following statement: "Biotechnology is the use of living things to create products and services to meet our needs and desires".**

The respondents were then asked whether they had heard of this before. More than two-thirds (68%) of respondents had never heard of biotechnology. However, nearly a quarter (24%) had heard of biotechnology before. Only a few respondents (9%) indicated that they did not know.

**To what extent do you agree that “biotechnology” is a risk to society?**

Just over two-fifths (42%) of respondents did not know whether they agreed or not with the statement that technology is a risk to society. Just over a fifth (21%) agreed or strongly agreed that technology is a risk to society. However, just a little over a quarter (26%) either disagreed or strongly disagreed that biotechnology was a risk to society. Just over a tenth (11%) said that they neither agreed nor disagreed with the statement.

**Respondents were also asked the extent to which they agreed that biotechnology is morally acceptable.**

Just over two-fifths (44%) of respondents did not know. Just over a quarter (27%) of respondents agreed or strongly agreed with the statement that biotechnology is morally acceptable. A little below a fifth (17%) disagreed or disagreed strongly that biotechnology is morally acceptable. Just a little over a tenth (13%) could not decide whether they agreed to the statement or not.

**People who had negative feelings about biotechnology, genetic engineering, genetic modification or cloning were asked what the single most important reason was for these negative feelings.**

Just over half (53%) of these respondents did not know whether there was any single most important reason for negative feelings toward the technologies. Around 15% of respondents the statement: “(it) is unhealthy for humans” as the single most important reason ascribed to these negative feelings. The second most important reason mentioned by respondents, with just a little over a tenth (11%) of the respondent proportion mentioning it, was the statement: “it violates religious/ethical principles”. At joint third place, with just under a tenth (8%) of respondents respectively mentioning it in equal measure, were the two statements: “(it) changes the taste or nutritional value of the food” and “(it) is just wrong”.

**Respondents were given practices that use biotechnology. They were then asked whether they thought these practices should either be stopped or continued.**

**Graph 2: Biotechnology Practices:**

From Graph 2 it is very clear that respondents felt that all biotechnology practices should be continued rather than stopped. Such sentiments were particularly acute in questions 144 (statement: “Making foods such as bread and cheese”) and questions 147 (statement: “making biodegradable plastics that are not harmful to the environment”) with a little more than three-fifths (62% and 61% respectively) expressing such sentiments. Overall, there were very few respondents that stated they did not know whether these practices should be stopped or not.

## **Trust**

**Respondents were also asked about organizations that they trusted the most to tell them the truth about biotechnology.**

Nearly a quarter (23%) seemed to trust universities the most to tell them the truth about biotechnology. The second most trusted institution seemed to be the media (19%). The third most trusted institution was the South African Government, with 16% of respondents trusting it to tell them the truth about biotechnology. Only about a tenth (11%) did not know an organization to trust to tell them the truth about biotechnology.

**Respondents were asked whether they agreed or not with the following statements:**

**Graph 3: Level of Agreement with Biotechnology Statements:**

Graph 3 illustrates general agreement with several statements, ranging from a high of 67% for the first statement to a low of 51% for the last statement level of agreement. Just over a quarter (27%) disagree with the statement: "I would buy genetically modified maize if it cost less than ordinary maize". Proportionally, a quarter (25%) of respondents did not know whether to agree or disagree with the statement: "I would be willing to eat the eggs of chickens fed on genetically modified maize" which was comparably higher than the proportion in other statements.

**Respondents were asked where they would most like to get information about biotechnology:**

Almost two-fifths (38%) of respondents indicated that they would most like to get information on television. However, nearly a quarter (23%) felt that they would most like to get information from all the media, including television, radio, newspapers, magazines, and the Internet. The third most chosen option seems to be radio alone as an option as well, with just over a fifth (22%) of respondents indicating this medium. Only a few respondents (7%) indicated that they were not interested in getting information about biotechnology.

**Finally, respondents were asked to choose only one use of biotechnology that they would like to know more about.**

Just over two-fifths (44%) of respondents indicated that they would like to know more about the 'health/medical' uses of biotechnology. Nearly a quarter (24%) would also like to know about GM foods or agriculture uses of biotechnology. Just over a tenth (13%) of respondents did not know which uses of biotechnology they would like to know about.

## **SECTION 2:**

### **An Index of biotechnology - 'The Negative Index':**

We took a few of the questions in the questionnaire and constructed an index of perception toward biotechnology. We were interested in the respondents who had negative feelings about biotechnology, genetic engineering, genetic modification, and cloning, as opposed to those who neither had positive nor negative feelings, who were positive or those who simply did not know. We assigned a value of 1 to those who were negative or very negative about biotechnology, genetic modification and cloning.

We also included questions where respondents answered that they thought the given list of new technologies that are currently developing will have a worse effect on our way of life in the next 20 years.

Also, the extent to which they agreed that biotechnology was a risk for society and that biotechnology was morally acceptable was included in the index, assigning 1 to those respondents agreed or strongly agreed with the statement that biotechnology was a risk for society, and a 1 to those who disagree or disagreed strongly that biotechnology is morally acceptable.

We also included respondents who gave a single most important reason why they had negative feelings about biotechnology. Also, those respondents who felt that biotechnology should be stopped. As to trust, we included respondents who did not trust any government institution.

The following are the questions were included into the index:

- Q. 118-Is this thought of biotechnology negative or positive?
- Q. 120- Is this thought of genetic engineering negative or positive?
- Q. 122- Is this thought of genetic modification negative or positive?
- Q. 124- Is this thought of cloning negative or positive?
- Q. 125-131- Of the following list of new technologies (i.e. Solar energy, computers & information technology, Biotechnology/genetic engineering, nanotechnology, space exploration, nuclear energy, and mobile phones/cell phones) that are currently developing, please say whether you think they will improve, worsen or have no effect on our way of life in the next 20 years.
- Q. 141- To what extent do you agree that “biotechnology” is a risk for society?
- Q.142- To what extent do you agree that biotechnology is morally acceptable?

In short, there were 19 questions included in the index. An index score was then devised, with those respondents scoring higher on the index having the most negative feelings, thoughts, attitudes or judgments or trust or moral outrage at biotechnology, genetic engineering, cloning, or creating products and services through using living things. Low scores on the index could have been a result of positive feelings toward biotechnology or lack of knowledge thereof. The Index-score ranged from 1 to 16. 1 was treated as the lowest score on the index and 16 was the highest score.

However, we found that there were very few people who scored above 10 on the negativity index. We therefore recoded the scale to run from 1 to 10 since we wanted to perform other analyses with the data that did not tolerate empty cells. What this also proves is that most respondents were not on the extreme scale of the negativity index, meaning that they were not as negative as we would have expected.

### **Findings:**

#### **The relationship between negative feelings toward biotechnology and income:**

A weak positive correlation ( $r=0,051$  and  $p=0,003$ ) exists between people's income and negative feelings towards biotechnology. In other words, people with higher incomes tend to score higher on the negative biotechnology index score than people with lower incomes. Similarly, people with lower incomes tend to score lower on the negative index.

The results are significant at the 99% level of confidence.

**The relationship between reading the information on food labels and negative feelings toward biotechnology:**

A weak positive but significant relationship ( $r=0.062$ ,  $p=0,000$ ) exists between negative feelings about biotechnology and the amount of time people read information on food labels.

In other words, the more often (or always) the respondent reads the information on food labels, the more negative he/she tends to become toward biotechnology. The less negative the respondent is toward biotechnology, the less often he/she tends to read information on food labels.

Interestingly, the level of confidence is higher at 99%.

**The relationship between race and negative feelings toward biotechnology:**

Using the chi-square test (Chi-Square=65.480,  $df=27$ ) for the nominal variable of race and the ordinal variable of negative feelings towards biotechnology, one finds a weak but significant relationship ( $r=0,054$ ,  $p=0,01$ ) between race and negative feelings toward biotechnology. In practical terms, more Blacks tended to score the lowest (e.g. 618 Black respondents out of a total of 975 obtained a score of 1 out of 10) on the biotechnology index. In contrast, fewer Whites and Indians ( $N=126$  and  $N=72$  respectively) obtained a lower score on the biotechnology index. However, both Whites and Indians had higher scores on the higher end of the index score ( $N=6$  and  $N=5$  on the index score of 10 respectively) compared to Coloureds ( $N=3$ ) on the same index score. However, Blacks bucked the trend by still scoring higher throughout the index. Therefore, there is a weak correlation between race and negative feelings toward biotechnology.

In other words, Blacks and Coloured tended to have less negative feelings toward biotechnology than Whites or Indians, who tended to have more negative feelings, judging by their higher scores on the biotechnology index. However, though the relationship is positive and significant, it is still weak. The reason for the weakness seems to be that Black respondents in particular had higher scores throughout the index.

**An Index of Biotechnology - 'The Bio-Knowledge Index':**

A separate index was made, based on the following questions which require a degree of knowledge of biotechnology to be answered. Therefore, unlike the previous index, this one tested real knowledge, with the respondent required to indicate whether the statement was true or false.

- Q. 134- Ordinary tomatoes, like genetically modified tomatoes, contain genes
- Q.135- By eating genetically modified food, your genes could also become modified
- Q. 136- Yeast brewed for beer is made of living things
- Q. 137- One can be able to determine, in the first few months of pregnancy whether a child has Down's syndrome or not

Q. 138- Genetically modified animals are always larger than ordinary animals.

Q. 139- It is possible to put animal genes into plants.

Except for the false response in question 135, all responses are supposed to be true. We then compiled an index-score for all the correct answers, recoded these 1 and made the rest of the 'incorrect' and 'don't know' responses into zeros.

### **The relationship between knowledge of biotechnology and educational qualification:**

Having calculated the chi-square statistic (Chi-Square=300.59, df=18), it becomes obvious that small but significant relationship exists between knowledge of biotechnology and educational qualification ( $r=0.347$ ,  $p=0.000$ ) Therefore a strong association exists between the two measures.

We can then try to predict whether an increase in educational qualification leads to an increase in knowledge of biotechnology or not, or in other words, is an increase in educational qualification leading to an increase on the bio-knowledge index score?

Since both of these variables, educational qualification and the bio-knowledge index, are ordinal, Kendall's tau-b is an appropriate measure of association, based on the number of concordant and discordant pairs, and with a correction for ties. The value will also indicate the direction of the monotonic relationship as it assumes values between  $-1$  and  $+1$ . A value of 0 denotes a complete absence of association, whilst  $-1$  denotes a perfect decreasing relationship and  $+1$  a perfect increasing relationship.

In our case, the value of the Kendall's tau-b was calculated as 0,368, a small, positive, but significant measure of association (i.e. a modest presence of association) indicating that an increase in educational qualification leads to an increase in the bio-knowledge index score. Such a paired association is also captured by the Pearson's correlation ( $r=0,347$ ) which is also small but significant.

### **The relationship between knowledge of biotechnology and negative feelings toward biotechnology:**

There is a weak but significant relationship ( $r=0,096$ ) between knowledge of biotechnology and negative feelings towards biotechnology,

However, one could not predict from one's knowledge of biotechnology and one's negative feelings toward biotechnology because the value of the predictive measure ( $\text{Lambda}=0,003$ ,  $p=0.214$ ) was so small and therefore knowledge of a respondent's index score is of no help at all in predicting the how one would score on the negativity index.

All that one can say is that a relationship exists between the two variables but one cannot make useful predictions from knowing the values of the one or other variable.

### **The relationship between Internet access and bio-knowledge scores:**

There is a small but significant (at 0.01 level of significance) correlation between Internet access and bio-knowledge scores ( $r= 0.223$ ). Therefore, those with access to the Internet, either at home, work/educational institution, both at home and at work, at an Internet café, or at a community centre, tended to score higher on the bio-knowledge score index than those with no access to the Internet at all.

### **The relationship between personal income and bio-knowledge scores:**

Again, a small but significant correlation between personal income and bio-knowledge scores ( $r=0.146$ ) was observed. Since this is a positive correlation, there is a tendency that shows that as income rises, so does one's score on the bio-knowledge index. The less the income, the less the score on the bio-knowledge index as well.

### **The relationship between access to reading and bio-knowledge scores:**

We also made another index composed of all the positive items in question 175 which asked: "Which of the following do you have in your household? The response could either be a "yes" - meaning access to that reading material, or "no" meaning no access to that reading material. There were eight options from which respondents could choose from, ranging from books, magazines, newspapers, comics, novels, educational games, internet connection to fax. A score of 1 was given to the presence of the reading material and a 0 was given to lack of access to the reading matter.

We found a small but significant correlation ( $r=0.100$ ) between access to reading material and bio-knowledge scores, meaning that the higher the score on the reading access variable, the higher the score on the bio-knowledge index. Also the lower the score on the reading access index, the smaller the score on the bio-knowledge index.

**A regression analysis of Internet access, access to reading, educational qualification, negativity index, personal income to predict bio-knowledge scores:**

We attempted to predict from all the variables that are associated with having access to resources, including access to the Internet (i.e. having access or no access to the Internet), access to reading (e.g. having access to books or magazines), having and some form of educational qualification, personal income and scores on the negativity index.

We performed a stepwise regression analysis where we included all the variables above as independent variables to predict a single dependent variable, the bio-knowledge index score.

When we ran the regression, the model we came up with showed that the variables of education ( $r=0.262$ ,  $R\text{-square}=0.069$ ), internet access together with education ( $r=0.291$ ,  $R\text{-square}=0.085$ ), reading access, together with internet access and education ( $r=0.304$ ,  $R\text{-square}=0.092$ ) and personal income, internet access, reading access and personal income ( $r=0.318$ ,  $R\text{-square}=0.101$ ). The negativity score index was excluded in the final because the beta value was not significant when compared to any of the other variables.

In summary, it is the value, which includes all the four variables in the model that is able to explain 10% ( $R\text{-square}=0.101$ ) in the bio-knowledge index score. The variances explained by the other variables are smaller but nevertheless significant. All the variables are positively related to the bio-knowledge outcome. Each variable, either as a single variable (e.g. education) or as a paired variable (e.g. education and internet access) is able to predict what the score on the bio-knowledge index will be.

### SECTION 3:

#### **Summary, conclusion, discussions and recommendations:**

From the results, it emerges that on average, nearly eight out of ten respondents interviewed did not know or had any knowledge about biotechnology. An equal number of respondents did not know what to think when they heard the word biotechnology, genetic engineering, genetic modification or cloning.

In terms of attitudes and judgments, nearly 7 out of 10 respondents had never heard of the definition of what biotechnology is. However, having heard it, nearly 4 out of 10 respondents did not know whether to agree or disagree with statements like "biotechnology is a risk for society", "biotechnology is morally acceptable". There was nearly an equal proportion; about a fifth (20%) of those who either agreed or disagreed that biotechnology is a risk for society. About a tenth (11%) of the remaining respondents were equivocal about whether biotechnology was a risk to society or not.

A little over two-fifths (44%) of respondents did not know enough about biotechnology to agree or not with the statement: "To what extent do you agree that biotechnology is morally acceptable?"

Respondents were also asked to state the single most important reason for their negative feelings towards biotechnology. Just over half (53%) did not know of any reason. Of the remaining percentage, the single most important reason for having negative feelings about biotechnology is that it is unhealthy for humans (mentioned by 15% of the respondents).

There were surprisingly many respondents, on average 6 out of 10 respondents, who felt that the current practices of using biotechnology to make foods such as bread and cheese, moving genes from plants to make crops resistant to insect pests, using living things to make medicines, and making biodegradable plastics should rather be continued as opposed to the 2 out of 10 respondents who said that such practices should be stopped. Again, this shows that most respondents were not as opposed to biotechnology as could be expected. It is just that most respondents seem not to know.

The university seems to be the most trusted institution to tell respondents the truth about biotechnology. Nearly a quarter of respondents indicated the university. The media and the government were second and third respectively.

We then tried to isolate the few respondents that seemed to be negative toward biotechnology. We compiled the negativity index whose scores ranged from 1 to 16, with 1 the lowest score on the index and 16 the highest score. If one obtained a higher score on the negativity index, it meant that one was more negative and if one obtained a lower score, it meant that one was less negative.

However, we subsequently found that in our analysis, there were fewer people who scored from 10 upwards on the negativity index. In comparing the index with other data, we found that we had too many empty cells at the upper end of the scale and

therefore had to treat these as missing data. What this means is that not many people had extreme negative feelings toward biotechnology.

We also found very weak but still significant relationships between our variables of interest (e.g. correlating income with the negativity index) and the negativity index itself.

We also constructed an index that had to do with how much factual knowledge respondents had about biotechnology. In the questionnaire, there were 6 items or statements that were either correct or incorrect. The respondent who answered the item correctly was given a score of 1 and if he answered incorrectly then he was given a score of 0. Therefore, the scores of the index ranged from 0 to 6, with 0 indicating a respondent who got all the answers wrong and 6 indicating the respondent who got all the answers right. Therefore, the scale is arranged in order of difficulty.

We also tried to correlate this scale with other variables like race, sex, income, education, Internet access, reading access and the negativity index itself. We isolated the variables that, either in single or in combination, were able to predict the variance in the dependent variable, bio-knowledge. These variables managed, though in a small way, to explain about a tenth of the factor that is responsible for the scores in the bio-knowledge index.

In conclusion, there does seem to be an indication that if one is educated, has some form of income, has access to the Internet, has access to reading material, is of a particular race group, then one tends to be either negative about biotechnology or even have more factual knowledge about it. In terms of race group, if one is either White or Indian, then one tends to have more negative feelings toward biotechnology than if one were Black or Coloured.

### **Implications for the future:**

Since most respondents do not know much about biotechnology, it is quite evident that a communications campaign has to be undertaken to educate the masses about what biotechnology can do. It is also encouraging to note that most people are not necessarily too negative about biotechnology, nor about their proven effectiveness given the fact that they would like what biotechnology is currently used for. In a sense, having so many people not knowing about biotechnology means that one can start from a very small base to build such knowledge of biotechnology rather than starting, say, from a well established but hostile base who adherents have made up their minds about the positive or negative aspects of biotechnology.

However, for those who are educated and have access to various media that informs them, presumably about taking decisions in one way or the other on whether to use biotechnology or not, it would be helpful to provide a more balanced view of the issues at hand, by for example, introducing other choice media explaining both the potential hazards and opportunities for biotechnology.

**Addendum A: Responses to the question: What do you think about when you hear the word biotechnology.**

- 01 'what people put in vegetables to let them grow quicker'
- 02 'improved way of producing'
- 03 'beauty'
- 04 'something to do with genetics'
- 05 'about people's health'
- 06 'like biology'
- 07 'combination of two things'
- 08 'study of performing stimulants of some kind'
- 09 'about body development'
- 10 'how they assess what is in food'
- 11 'to do with human beings'
- 12 'using robots on peoples bodies'
- 13 'food produce'
- 14 'treatment of food'
- 15 'waste product to create energy'
- 16 'something biological'
- 17 'electronics'
- 18 'creativity'
- 19 'organic growth'
- 20 'to better our lives'
- 21 'fresh & being tested for human consumption'
- 22 'my body is about to be a robot'
- 23 'biological technology'
- 24 'study of bacteria'
- 25 'controlling of genes'
- 26 'advanced technology'
- 27 'computers'
- 28 'genetically engineered foods'
- 29 'technology help stimulents of food'
- 30 'ecologically friendly'
- 31 'medical technology'
- 32 'is the use of some things to create products'
- 33 'making things which are scarce to be there most of the time (maize)'
- 34 'improvement of environment'
- 35 'project to uplift microbiology genetics'
- 36 'chemicals used in the laboratory'
- 37 'dry food that can be eaten in certain years'
- 38 'plant & animals'
- 39 'technology involves living things'
- 40 'food processing technology'
- 41 'sickness / unhealthy'
- 42 'atom bomb – weapons'
- 43 'changes cells + plants to grow better'
- 44 'modern language'
- 45 'energy we get through our bodies'
- 46 'designing electrical materials'
- 47 'study of science'

- 48 'technology that improves everybody'
- 49 'cellphones'
- 50 'creation'
- 51 'technology that rotates'
- 52 'parts of the body'
- 53 'things you make continuously by using your brain'
- 54 'course offered at university'
- 55 'improvement of people's lives – cure for cancer'
- 56 'food being changed everyday'
- 57 'changing of things into modified stuff'
- 58 'creation of products'
- 59 'desire of needs and service'
- 60 'biology & technology'
- 61 'new inventions'
- 62 'make my own business using technology'
- 63 'to think about my own knowledge'
- 64 'about art'
- 65 'food that is natural does not have added ingredient'
- 66 'something I can come up with'
- 67 'check foods expiring dates'
- 68 'unusual thing happening around'
- 69 'study of some kind'
- 70 'something to do with life'
- 71 'science'
- 72 'business'
- 73 'study of natural food resources & how to best manage them'
- 74 'insects'
- 75 'use of bacteria to improve products'
- 76 'nature a life joined together'
- 77 'Living things from which they make medicine / products'
- 78 'sport injuries'
- 79 'muscles science'
- 80 'process of nature / science'
- 81 'advancement of extra energy'
- 82 'exercise'
- 83 'pure'
- 84 'investigation in plants'
- 85 'experiments in labs'
- 86 'manufacturing of things / food'
- 87 'product'
- 88 'environment a technology & reproduction relationship'
- 89 'less diseases'
- 90 'development of food'
- 91 'food that contains organic substances'
- 92 'organic chemistry'
- 93 'modern items'
- 94 'bioslim'
- 95 'danger in most work places'
- 96 'birth'
- 97 'robot type of things – mechanical'

- 100 'technology of the human body'
- 101 'crops – eg. vegetables'
- 102 'think of laboratories'
- 103 'genetic manipulation of food'
- 104 'intervene with God's work'
- 105 'study of ingredients of motor'
- 106 'use live products to meet our needs'
- 107 'study of biology & living things'
- 108 'genetic changes in plants'
- 109 'using living cells to improve plants'
- 110 'buy arms'
- 111 'positive connotation'
- 112 'poisons'
- 113 'study of creation of plants / people'
- 114 'produce food chemically'
- 115 'technology that increases a healthy lifestyle'
- 116 'manipulation of stuff new heart'
- 117 'experimenting with germs'
- 118 'study of genetics & living things'
- 119 'plants, animals, cloning'
- 120 'study of living things'
- 121 'study of duplicate genes'
- 122 'something like cancer or other body illness'
- 123 'to do with organisms'
- 124 'sports'
- 125 'the use of stuff you eat & drink'
- 126 'bad idea'
- 127 'when you lose a limb, they will replace it'
- 128 'changing plants genetically'
- 129 'something good to do with the things we eat'
- 130 'to create a living things by using technology'
- 131 'human body'
- 132 'health issues'
- 133 'biology & something to do with the food we eat'
- 134 'technology to manipulate life'
- 135 'study of human technology'
- 136 'genetic studies are used to improve quality of food'
- 137 'research & development of plants / foodstuffs'
- 138 'bring technology to each and every South African'
- 139 'developing bio-products. like soups.& powered ingredients'
- 140 'damage of environment'
- 141 'break down of food – scientific'
- 142 'chemical food'
- 143 'chemical engineering of seed'
- 144 'use of genetics to make things'
- 145 'nuclear chemicals'
- 146 'study of foods'
- 147 'something to do with human and animal life'
- 148 'process of food'
- 149 'detergent'

- 150 'genetics'
- 151 'create new foods'
- 152 'something to do with nature'
- 153 'people trying to enforce foreign technology in food & everthing else'
- 154 'food should be grown on tis own not using chemicals'
- 155 'something to do with brains'
- 156 'fertilizer'
- 157 'viruses, chemicals'
- 158 'communication'
- 159 'education'
- 160 'consumer friendly'
- 161 'to study for a long time'
- 162 'putting different chemicals in food stuffs'
- 163 'technology involving biological organisms'
- 164 'technology involving chemicals & developing something'
- 165 'technological approach to agriculture & environment eg. rain forests etc.'
- 166 'mass produce something'
- 167 'development & biology'
- 168 'drawing'
- 169 'fake goods that comes with the nigerians & chinese'
- 170 'making things grow quicker than usual eg. chickens using lights 24hrs so that they grow quicker'
- 171 'reproduction'
- 172 'money'
- 173 'healthy food'
- 174 'weapon of mass destruction'
- 175 'biological science in conjunction with modern science'
- 176 'technology regarding physiological issues'
- 177 'use of living things to make food & medicine'
- 178 'chemistry'
- 179 'bio means earth'
- 180 'doubling cell tissuesness'
- 181 'best development of medication'
- 182 'using organisms to change plants'
- 183 'some kind of movie'
- 184 'chemicals on food & people'
- 185 'it is food with protein that can be cooked at a certain time eg. soya'
- 186 'nature development of vegetables fruit'
- 187 'technology of the army'
- 190 'improvement'
- 191 'bio-chemical warfare'
- 192 'about future'
- 193 'interfering with nature'
- 194 'mass production'
- 195 'using live micro organisms to make new products'
- 196 'products made by man'
- 197 'machine'
- 198 'evolution'
- 199 'when natural products work with artificial products'
- 200 'natural resources to produce food for human consumption'

- 201 'altering food sources to make better food'
- 202 'earth'
- 203 'create scientefically food tested by scientist made in LAB'
- 204 'scientists create food – no control, contaminating food'
- 205 'tomatoes grown under greenhouse – chemically grown'
- 206 'create demands'
- 207 'something that is not natural'
- 208 'mechanical body parts, limbs / hands'
- 209 'motor cars'
- 210 'food that is artificial'
- 211 'test soemthing to see if it is good enough'
- 212 'technology of human food'
- 213 'testing people'
- 214 'making of subsances'
- 215 'genetically modified food/medicine'
- 216 'indigenous knowledge'
- 217 'changing in technology of organic substances'
- 218 'medicine'
- 219 'combination of food (positive & negative)'
- 220 'free produced products'
- 221 'biological manipulation of genes'
- 222 'to make plants bigger & tstier – improve technology'
- 223 'don't believe it is wrong'
- 224 'food supplement'
- 225 'produce products by biodegradable products'
- 226 'enhance foods'
- 227 'system used for plants/animals that protects them and makes them healthier'
- 228 'use of chemicals on vegetables & fruits'
- 229 'loosing weight'
- 230 'food engineered'
- 231 'its about natural resources – like water'
- 232 'use of living organisms to make others'
- 233 'using seeds in lab to create food'
- 234 'science of movement -human body'
- 235 'upgrading'
- 236 'creating your own adventure'
- 237 'manufacturing pills/tablets'
- 238 'dangerous things – germs etc.'
- 239 'technical things'
- 240 'technical biological experiment with human & food stuff'
- 241 'intelligence'
- 242 'school'
- 243 'progress'
- 244 'study of human science'
- 245 'scientific manufacturing of foods'
- 246 'craftmanship'
- 247 'mielies – genetically manipulated'

## **Addendum B: Responses to the question: What do you think about when you hear the word genetic engineering**

- 01 'something to do with cars'
- 02 'natural way of producing'
- 03 'heal'
- 04 'modifying foods'
- 05 'something negative to human race'
- 06 'something handmade'
- 07 'when you build a bridge you need engineering'
- 08 'engine work'
- 09 'combination of genes'
- 10 'controlling of genes in living things'
- 11 'producing brighter people'
- 12 'making of and working of food'
- 13 'like mollie the sheep and plants'
- 14 'construction'
- 15 'training'
- 16 'machinery'
- 17 'change peoples bodies with genetics'
- 18 'transport'
- 19 'science'
- 20 'creativity'
- 21 'radiation'
- 22 'produced items'
- 23 'must be much healthier but as far as I am concernd not fully tested'
- 24 'could be used for benefits'
- 25 'I think about cloning'
- 26 'Research in genetics genes'
- 27 'manipulation of composition of foods'
- 28 'better of pets and sweetness'
- 29 'manipulation of genes'
- 30 'creating superman'
- 31 'help to improve and detect bacteria on food & water'
- 32 'injecting genes'
- 33 'according of physics'
- 34 'sickness'
- 35 'food for more people'
- 36 'motor technology'
- 37 'function of blood vessels in the body'
- 38 'body function'
- 39 'functioning of kidney'
- 40 'making of new things'
- 41 'DNA tests'
- 42 'making of things that uses electricity'
- 43 'engineering'
- 44 'creation of things – maybe artwork'
- 45 'people who work with hands'
- 46 'technology'
- 47 'teach us to make bombs & iron'

- 48 'converting plants'
- 49 'health'
- 50 'artificial power'
- 51 'improving some food technically'
- 52 'elements'
- 53 'trying to change course of nature. messing around with process of development of food sources'
- 54 'improvement of colour in certain foods eg. apples & tomatoes'
- 55 'dangerous'
- 56 'muscles in the body'
- 57 'when a baby has a high temperature'
- 58 'not original but generic'
- 59 'enhancing products'
- 60 'Use of genetics to obtain a "optimum species that would be disease resistant & maximise yields'
- 61 'course offered in university'
- 62 'resemblance'
- 63 'plants & vegetables'
- 64 'enlarging food'
- 65 'to do with family tree'
- 66 'it has been changed from original'
- 67 'help women to have babies'
- 68 'modifying natural state'
- 69 'doctors'
- 70 'sexuality'
- 71 'knowledge'
- 72 'unnatural / artificial reproduction'
- 73 'development'
- 74 'research of food before sold'
- 75 'alternatives'
- 76 'manipulation of seeds'
- 77 'germs'
- 78 'growth modern'
- 79 'genetic manipulation of DNA'
- 80 'to improve farming'
- 81 'inheritance'
- 82 'drawing'
- 83 'making things easier for everyone'
- 84 'operation'
- 85 'engineering of genes by securities – manufacturing new life'
- 86 'tests / trials'
- 87 'genetic changes in peoples bodies'
- 88 'I think it is modification'
- 89 'artificial implanting'
- 90 'when they try to make something the same as the original'
- 91 'manufacturing of new genetic products'
- 92 'making new plants'
- 93 'preparing of food'
- 94 'positive connitation'
- 95 'bad'

- 96 'improving life, animals, plants'
- 97 'not from nature, from a lab'
- 100 'hereditary genes'
- 101 'something to do with body parts'
- 102 'help from someone'
- 103 'medication that sportmen use'
- 104 'something to do with the food we eat'
- 105 'something to do with genes & engineering'
- 106 'genetic environment and engineering'
- 107 'something used by civil engineers'
- 108 'canning of food'
- 109 'genetics'
- 110 'genes they use to make a product'
- 111 'power'
- 112 'human genes'
- 113 'organs of my body'
- 114 'nature thing'
- 115 'engineering in foods'
- 116 'genes that have been improved'
- 117 'something about fabric'
- 118 'being against nature'
- 119 'weapons made'
- 120 'abnormal of children'
- 121 'generic crops'
- 122 'creating of genes'
- 123 'changing of strength in life of DNA'
- 124 'engineering of genes'
- 125 'not satisfied with my life'
- 126 'physical like going to the doctor for a check-up'
- 127 'electricity worked -Telkom or Eskom'
- 128 'human engineering'
- 129 'energy'
- 130 'petrol – garages'
- 131 'more chemicals in food'
- 132 'pesticides'
- 133 'chemical processing'
- 134 'being strong'
- 135 'make up of our DNA'
- 136 'making people'
- 137 'examination of body – cells/genes'
- 138 'enhance people make-up'
- 139 'cheaper & affordable'
- 140 'imported goods that needs to be exported to other country'
- 141 'brilliant & flexibility of person'
- 142 'manufacturing artificially'
- 143 'engineering chromosomes & genetics'
- 144 'technology of reproduction'
- 145 'altering genetics of palnts & animals'
- 146 'selecting genes for best outcome for agriculture'
- 147 'to do things freely with enthusiam'

- 148 'stems cells – to cure alzheimers'
- 149 'medical'
- 150 'area of high risk responsibility'
- 151 'unnatrual reproduction'
- 152 'robots'
- 153 'things that are created by machines – chickens & fruit'
- 154 'mines & minerals'
- 156 'biological engeneering'
- 157 'the way ingrediants is mixed to produce healthy food'
- 158 'big power ventilators'
- 159 'working with genes of food'
- 160 'plants & DNA'
- 161 'unnatural activities'
- 162 'plants and animals'
- 163 'find plant to improve food'
- 164 'body turning disease'
- 165 'architecture'
- 166 'genetic evolution'
- 167 'making new life in labs'
- 168 'plants grow without seeds'
- 169 'some kindof workshop'
- 170 'soya food eg. soya mince food that has to be half cooked'
- 171 'keeping body strong'
- 172 'changing genes of babies'
- 173 'people playing god'
- 174 'changing animals in terms of practicing experiments'
- 175 'babes'
- 176 'man-made'
- 177 'recreational'
- 178 'anti-viral engineering'
- 179 'genetics is changed into something else'
- 180 'alter DNA structure of plants & animals'
- 181 'growing things faster than normal'
- 182 'genetically altering things to grow how we want them to'
- 183 'modify – genes of plants to make it stronger'
- 184 'gene of fish into orange'
- 185 'study of genes – human structure'
- 187 change genetic cells to maka it better'
- 188 'progress'
- 189 'man made genes'
- 190 'takes genes & make a product'
- 191 'a women that has a sickness 7 carries it over to her child'
- 192 'water'
- 193 'working with cells'
- 194 'healing a sick person'
- 195 'houses'
- 196 'used to produce plants'
- 197 'movies'
- 198 'steel structure of buildings'
- 199 'scientists using genes to modigy foods, animals'

- 200 'quality of things that are decreasing'
- 201 'when genetics of something is engineered to evolve or become bigger'
- 202 'biotechnology'
- 203 'produce crops which survive'
- 204 'fake cows'
- 205 'scientific research & cloning'
- 206 'scientific advance'
- 207 'changing form of something'
- 208 'changing genes to suit us'
- 209 'changing DNA & cell-enhance its ability to produce better quality of life'
- 210 'sin according to the bible'
- 211 'changing food for better production'
- 212 'carefully optimistic'
- 213 'who you are & what goes on inside you'
- 214 'mechanics'
- 215 'adaption to improve your ability'
- 216 'modified crops'
- 217 'genes into plants'
- 218 'manipulation of something'
- 219 'use genetics to regenerate cells in body'
- 220 'taking out cells from unborn fetus to find cures of diseases'
- 221 'maize – genes engineered'
- 222 'cells of something'
- 223 'its something from water to electricity'
- 224 'genetic manipulation of genes'
- 225 'take bad things out and put good things in'
- 226 'grow vegetables in lab'
- 227 'seed in laboratory - to cultivate agriculture'
- 228 'transfer of genes'
- 229 'artificially engineer food products to withstand certain viruses'
- 230 'sports people'
- 231 'machine design'
- 232 'movement'
- 233 'science/like telescope going apart with science'
- 234 'genetic processed goods'
- 235 'genetical scientific experiments, to obtain more info on how genes work & can improved'
- 236 'oil'
- 237 'work with land'
- 238 'generating artificial things'
- 239 'genetic investigation'
- 240 'the nature'
- 241 'people who is looking at places to see if its good'
- 242 'showing red at powerstation'

**Addendum C: Responses to the question: What do you think about when you hear the word genetic modification.**

- 01 'modifying food for many people'
- 02 'present cancer & genetic diseases'
- 03 'changing the structure in living things'
- 04 'improvement'
- 05 'changing of genes'
- 06 'it's the coping of genes'
- 07 'vegatables'
- '08 tecnology'
- 09 'creativity / developing'
- 10 'manipulation of genes'
- 11 'unnatural way'
- 12 'interfering with nature'
- 13 'negative to the people'
- 14 'no seactim'
- 15 'physical being & fitness'
- 16 'don't like it al all'
- 17 'altering of DNA / genes'
- 18 'sickness'
- 19 'modification of genes'
- 20 'modify health in SA'
- 21 'Science'
- 22 'the homozones function of the tissue cells in body'
- 23 'it dried fruit not sure'
- 24 'I think its genes'
- 25 'new methods of education'
- 26 'genes'
- 27 'engineering / mechanic'
- 28 'make products taste good'
- 29 'modifying plants / humans & animals'
- 30 'red oranges inside'
- 31 'body booster'
- 32 'change of food flavour'
- 33 'change of coulor'
- 34 'car repairs'
- 35 'scientific chemicals to grow food'
- 36 'growth'
- 37 'sex change'
- 38 'change substances'
- 39 'genes to improve environment'
- 40 'changing your looks'
- 41 'something to do with animals'
- 42 'to make one animal out of another'
- 43 'modifying natural state'
- 44 'good & bad modification'
- 45 'it has to do with the change of family tree'
- 46 'facelifting cosmetics'
- 47 'I know that as well'

- 48 'nerves'
- 49 'cloning'
- 50 'negative'
- 51 'handeling things'
- 52 'ingredients'
- 53 'unaware'
- 54 'cleaning germs'
- 55 'sins'
- 56 'germans'
- 57 'I think about my feelings'
- 58 'artificial food'
- 59 'good for poor countries'
- 60 'sending things in a different direction'
- 61 'other population'
- 62 'girls playing soccer'
- 63 'cheaper version of orginal'
- 64 'crafting of seeds'
- 65 'medication'
- 66 'alliers'
- 67 'strorage of food'
- 68 'muscles'
- 69 'art'
- 70 'be careful of area'
- 71 'to speed up the process'
- 72 'robot people'
- 73 'change animal into grasshopper'
- 74 'genuine things'
- 75 'experiment on poor people'
- 76 'modify God's work'
- 77 'spray pesticides'
- 78 'modify plants not to reproduce'
- 79 'play with genes'
- 80 'It's the new cars of today & all the new parts'
- 81 'people, making a super race'
- 82 'remodeling houses'
- 83 'doctors stuff'
- 84 'to test to determine parenthood'
- 85 'the loss of indegenous'
- 86 'dolly the sheep'
- 87 'to feed the millions'
- 88 'cheatiry'
- 89 'fake cars'
- 90 ' by modifying genes it can be disasterous eg. people can get disabled'
- 91 'adopting to life'
- 92 'new ideas that comes everyday'
- 93 'brabery'
- 94 'is osomething used maybe on soil or grass that used to feed the cow so that they can make a lot of milk'
- 95 'making plants grow faster'
- 96 'medical'

- 97 'to grow something in specific direction'
- 98 'manipulators of genetic material'
- 100 'to stop certain genes & bring others in'
- 101 'plants & maize manipulate & give ox hormones'

**Addendum D:**

**Responses to the question: What do you think about when you hear the word cloning.**

- 99 'don't know'
- 98 'refuse to answer'
- 01 'not interested'
- 02 'people & animals are cloned'
- 03 'sheep & ox to be cloned'
- 04 'something to do with DNA'
- 05 'step forward'
- 06 'it's a sin'
- 07 'mollie/dollie the sheep'
- 08 'changed people to look alike and animals can be changed to humans'
- 09 'system of creating human appearance'
- 10 'dont think it mus be done on people'
- 11 'duplication of animals/humans and plants'
- 12 'reproducing'
- 13 'animals'
- 14 'create new life'
- 15 'cloning new borns'
- 16 'super human nature'
- 17 'modern technology'
- 18 'manipulation'
- 19 'terrible process'
- 20 'exact copy'
- 21 'not christian'
- 22 'it doesn't sound right'
- 23 'manuafactuirng people or animals'
- 24 'multification of sheep'
- 25 'mummies'
- 26 'clowns'
- 27 'sickness'
- 28 'combination of semen'
- 29 'household stuff'
- 30 'human reproduction'
- 31 'chemicals'
- 32 'clothes'
- 33 'something about blood'
- 34 'certain iron'
- 35 'genes in living things'
- 36 'cloning'
- 37 'thinking of birds'
- 38 'immitation'

- 39 'grossbreeding'
- 40 'deperdse stemsels'
- 41 'grown on your head'
- 42 'wrong in Gods eyes, He made everyone unique'
- 43 'stront'
- 44 'good, but must be controlled'
- 45 'it is a copy that is exactly the same'
- 46 'getting involved in Gos's respnsibility'
- 47 'unnatural'
- 48 'artificial reproduction of life'
- 49 'changing'
- 50 'curing of diseases'
- 52 'dangerous'
- 53 'upset'
- 54 'negative'
- 55 'science'
- 56 'unawate'
- 57 'laughter'
- 58 'organs'
- 59 'replanting'
- 60 'something with the stafs in the sky'
- 61 'the way you grow food in the light'
- 62 'something to do with drugs people take eg. sports'
- 63 ..
- 64 'it's a leave'
- 65 'the making of product activity'
- 66 'it how babies are made'
- 67 'monster humans without souls'
- 68 'biotechnology / nutrition'
- 69 'storage of food'
- 70 'birth transplant'
- 71 'joke'
- 72 'killing people, put them in a museum eg. like Saartjie Boortman'
- 73a 'something to do with our throat and sleeping'
- 73b 'a baby born with a clever brain'
- 74 'it has to do with outstanding people'
- 75 'procedures'
- 78 'spray pesticides'
- 79 'making replicants of individuals by cloning DNA cells'
- 80 '2 dogs created 1 dogs dies owner want the same dog cloned'
- 81 'try to derive one cell to make another cell'
- 82 'very cruel'
- 83 'making dummies of living things'
- 84 'materials'
- 85 'something to do with music'
- 86 'this is where you put an egg of someone else in a human'
- 87 'split embrio to make one'
- 88 'type of chronical sickness'
- 89 'keeping food fresh'
- 90 'it is a storage of fruit & veg to keep them fresh'

- 91 'something to do with water'
- 92 'cheating'
- 93 'it very trusty'
- 94 'threrpatic – cloning is fine'- cure reproductive cloning not good'
- 95 'tie animal to represent reproduction sterilized'
- 96 'clone a cow and make another human being'
- 97 'making individuals without DNA'
- 98 'poor sheeps'
- 100 'a goat male & female take sperm & see what will come'
- 101 'something deaing with milking of the cows'
- 102 'mixture of things'
- 103 'human cells saves your life'
- 104 'its something that is helping plants & animals to grow fast so that people cold have it early before a season'
- 105 'something to with giving birth'
- 106 'creating a new genes'
- 107 'spliting of cells'
- 108 'maybe if I swallow medicine it will help me'
- 109 'create people'