National Certificate of Educational Achievement
TAUMATA MĀTAURANGA Ā-MOTU KUA TAEA

Exemplar for Internal Assessment Resource

Biology Level 3

Resource title: Selective Breeding vs. Transgenesis

This exemplar supports assessment against:

Achievement Standard 91607

Demonstrate understanding of human manipulations of genetic transfer and its biological implications

Student and grade boundary specific exemplar

The material has been gathered from student material specific to an A or B assessment resource.

Date version published by Ministry of Education: December 2012
To support internal assessment from 2013

Please note that the exemplars may only provide a sample of the complete student work.

	Grade Boundary: Low Excellence
1.	At Excellence the standard requires the student to demonstrate comprehensive understanding of human manipulations of genetic transfer (EN 3) and its biological implications (EN 2). This involves linking biological ideas about human manipulations of genetic transfer and its biological implications, which may involve the impact on (EN4): • ecosystems • genetic biodiversity • health or survival of individuals • survival of populations • evolution of populations. The student just meets the criteria for Excellence by linking the biological concepts and processes for the human manipulations of selective breeding (2) and transgenesis (1). The biological implications and their impact relating to each of these manipulations has also been addressed: • selective breeding (3), genetic biodiversity (4), which includes examples and the health and survival of individuals or populations (5) • transgenesis (6), health and survival of populations (7), evolution of populations (8) and biodiversity (9). There is evidence of linking ideas by justifying and comparing and contrasting (10), which provides enough evidence to confirm Excellence. The student could more convincingly secure this grade at Excellence by: • including more evidence of biological terms relating to the relevant manipulation techniques (e.g. restriction enzymes and ligation) at Level 8 of the curriculum • presenting the biological implications section more effectively than just considering the advantages and disadvantages, e.g. by linking the implications of transgenesis to the ecosystem, and the consequences to the health and survival of individuals and thus populations.

Selective breeding can be described as 'Evolution by human selection, selective breeding may be methodical or unconscious, methodical selection is orientated towards a pre-determined standard whereas unconscious selection is the result of biases in the preservation of valuable individuals.'

Marker assisted selection (MAS) is a process whereby a marker (morphological, biochemical or one based on DNA/RNA variation) is used for indirect selection of a genetic determinant of a trait of interest e.g. productivity, disease resistance. MAS can be useful for traits that are difficult to measure, exhibit low heritability, or are expressed late in development

This process is often used in plants, as considerable development in biotechnology have led plant breeder to develop more efficient selection systems to replace traditional phenotypic-based selection systems
There is a large range of markers such as morphological, biochemical, or ones based on DNA/RNA variation available to those who are involved in MAS.

Steps for MAS include firstly mapping the gene or quantitative trait locus (QTL) of interest first by using different techniques and then use this information for marker assisted selection. Generally, the markers to be used should be close to gene of interest in order to ensure that only minor fraction of the selected individuals will be recombinants. Generally, not only a single marker but rather two markers are used in order to reduce the chances of an error due to homologous recombination. For example, if two flanking markers are used at same time with an interval between them of approximately 20cM

Several features make some markers of greater use than others. An ideal marker is

-Easy recognition of all possible phenotypes (homo- and heterozygotes) from all different alleles
-Demonstrates measurable differences in expression between trait types and/or gene of interest alleles, early in the development of the organism
-Has no effect on the trait of interest
-Low or no interaction among the markers allowing the use of many at the same time in a segregating population

(2)

(4)

Disadvantage: selective breeding gets rid of variety compared to the advantage selective breeding rules out weakness and disability disadvantage: isn't that what Hitler tried to do with humans in WWII? Do we really want to be like him? Selective breeding(or artificial selection) produces traits which may be advantagious to us, but be a disadvantage to the animal.Here are some examples-The lapps of northern Europe herd and breed the wild deer, selecting docile animals. The resulting herds could not survive in the wild.Cows with big udders are good for us , but are probably painful for the cow. English bulldogs mght be considered a cool looking dog, but have breathing difficulties and such small pelvises that they often have to give birth by causation.

(3)

(5)

Advantages: The use of selective breeding will produce plants that have greater disease resistance, can survival for longer period during a drought, of periods of high rainfall, or even greater susceptibly to extreme temperatures. This has strong linked to survival of individuals and populations. Improved resistance to factor which would usually result in the death of the plant, also means that plant crops are going to be more reliable, and less likely to become victims of the environment

(4)

Disadvantages: However selective breeding also has negative affect on genetic bio-diversity. For example a plant specifically designed to cope under extreme heat, or lack of water, has the potential of being destroyed by cold, or surface flooding during times of increased rainfall. This can prove to be detrimental when entire crops are resistant to a particular common disease, and another disease destroys every plant in the crop. As almost all plants are identical there will be very few/no survivors. Selective breeding also has the disadvantage of also a plant's marker indicates that the desired trait is present. It still takes considerable time to create an entire crop that is homozygous dominant for that particular trait.

A transgenic crop plant contains a gene/genes which have been artificially inserted instead of the plant acquiring them through pollination. The inserted gene sequence (known as the transgene) may come from another unrelated plant, or from a completely different species: transgenic Bt corn, for example, which produces its own insecticide, contains a gene from a bacterium. Plants containing transgenes are often called genetically modified or GM crops.

Among the most important tools in the genetic engineer's tool kit are enzymes that perform specific functions on DNA. The structure of DNA as a double helix with the phosphate backbone and the bases. Restriction enzymes which recognize and cut the DNA at a specific region of the DNA, other enzymes known as ligases join the ends of two DNA fragments. These and other enzymes enable the manipulation and amplification of DNA, essential components in joining the DNA of two unrelated organisms.

Identifying and locating genes for agriculturally important traits is currently the most limiting step in the transgenic process. Little is known about the specific genes required to enhance yield potential, improve stress tolerance, modify chemical properties of the harvested product, or otherwise affect plant characters. Usually, identifying a single gene involved with a trait is not sufficient; scientists must understand how the gene is regulated, what other effects it might have on the plant. Research programs are investing heavily into new technologies to rapidly sequence and determine functions of genes of the most important crop species. These efforts should result in identification of a large number of genes potentially useful for producing transgenic varieties. (1)

Advantages: A plant breeder tires to assemble a combination of genes in a crop plant which will make it as useful and productive as possible. Depending on where and for what purpose the plant is grown, desirable genes may provide features such as higher yield or improved quality, pest or disease resistance, or tolerance to heat, cold and drought. (7) Combining the best genes in one plant is a long and difficult process, especially as traditional plant breeding has been limited to artificially crossing plants within the same species or with closely related species to bring different genes together. Transgenic technology enables plant breeders to bring together in one plan useful genes from a wide range of living sources, not just from within the crop species or from closely related plants. (8) This technology provides the means for identifying and isolating genes controlling specific characteristics in one kind of organism, and for moving copies of those genes into another quite different organism, which will then also have those characteristics and create a new species with the desired trait. This powerful tool enables plant breeders to do what they have always done, generate more useful and productive crop varieties containing new combination of genes, but it expands the possibilities beyond the limitations imposed by traditional cross-pollination and selection-techniques (6)

Disadvantages: Transgenesis shares many similar disadvantages with selective breeding. Although in often considered more reliable and more efficient, transgenesis exhibits the same negative effects as selective breeding. (9) Most notably, transgenesis has a huge negative influence on genetic bio-diversity. Once a crop could include a huge variety of plants which had an extensive variety in genetic make-up, including its immunity to harmful environmental factors, now crops which may be made up entirely off GM plant, mean that although they will most likely exhibit one or several advantages listed above, it may also lack a immunity, or resistance, which could have huge negative potential.

Therefore to conclude I believe that it is evident that both selective breeding and transgenesis are great tools which can be used to manipulate genetic transfer to the betterment of the plants survival rate. Although I identify both to be usefully and potentially successful, I must conclude that selective breeding is the better option, for genetic manipulation. I justify this point of view by a few simple points.

- As opposed to transgenesis, selective breeding does not create a new species. As foreign genes are not inserted
- The effects on bio-diversity are less like to be as detrimental, as the effect caused by transgenesis. This is because recessive genes may still be present. Therefore in event of a disaster, in which all plants created by transgenesis will die, those a result of selective breeding will not necessarily die. (10)
- Selective breeding is considered more ethical. In the past Transgenesis has caused outcry by numerous environmental groups which claim it is unethical.

Therefore it is quite clear to see that although both methods are useful selective breeding is the future of genetic transfer and manipulations.

	Grade Boundary: High Merit
2.	At Merit the standard requires the student to demonstrate in-depth understanding using biological ideas to explain how humans manipulate genetic transfer (EN 3) and the biological implications of these manipulations (EN 2). The student provides evidence of in-depth understanding of the concepts and processes for the human manipulations selective breeding (1) and transgenesis (2). There is also evidence of explanation of at least two implications for each manipulation: • selective breeding on health and the survival of the individual (3, 4), and on genetic biodiversity and the survival of populations (5) • transgenesis on ecosystems and the evolution of populations (6, 7). To reach Excellence the implications section needs to be more effectively integrated by linking the biological ideas and implications using terms and supporting evidence at Level 8 of the curriculum.

The process involves the transversal of thousands of genes from two selected parents (that have desirable traits) of the same species into offspring to produce an organism that contains those desirable traits. E.g. two apples have a desired red skin; therefore they will breed the two apples together and produce offspring with that trait. A technique scientist's use is artificial insemination which is when they take the sperm (or pollen) from the selected male and put it in the female artificially. This process means that the good qualities are magnified and the bad close to eliminated. Another technique used in selective breeding is test crossing; scientists use test crossing to determine the unknown genotype of the organism. For example scientists have a brown eyed dog and want to determine whether it has the recessive gene that gives a dog blue eyes; they will then mate it with a homozygous recessive dog (a dog with blue eyes). When the litter is born, they will check the puppies to see if they have blue or brown eyes, if no blue eyed puppies are produced it means that the dog with the unknown genotype is homozygous dominant, but if blue eyed puppies are produced it means that the dog with the unknown genotype is heterozygous (meaning it carries both the recessive blue eyed gene and dominant brown eyed gene. Transgenesis is another type of genetic manipulation; it is the transfer of genetic material from one species to another to give that species a wanted trait. E.g. a weed is resistant to herbicide so scientists will cut out that particular gene and put it in a desired plant making that plant resistant, but also changing the entire species. A biological technique that scientists use in transgenesis is restriction enzymes. This process involves inserting enzymes into a selected organism, the enzyme then travels to its recognition site and cuts out the double stranded DNA molecule that is wanted. The strands where the DNA molecules have been cut away from then join back together. After they have collected the DNA molecule and then want to insert into the desired cell, scientists use a process called ligation. This process involves inserting the piece of DNA molecule into the DNA of the selected organism then an enzyme ligase joins the DNA molecule to the DNA strand, therefore making the DNA recombinant (this means that two different types of DNA have been joined together) and giving the organism the desired trait as well creating a new species.

Many people believe that selective breeding is the more appropriate way of getting the wanted trait in a species because we are not actually creating a new species, just getting the best of that organism. Here are various advantages of selective breeding. Selective breeding can be an advantage economically an example of this is; a farmer is able to choose cows that produce a lot of milk, not cows that don't produce any. The farmer can breed these cows with each other, meaning that the gene that allows cows to produce a lot of milk will be passed down to future generations. After a few years the famer will have a large population of high milk producing cows, therefore the farmer will be able to earn more money of the milk. Another advantage can be for the organism itself; selective breeding of animals with no genetic diseases will over time eliminate genetic diseases being passed down through the generations meaning that the organism will be able to survive longer and be healthier. Now onto the advantages of transgenesis; a big advantage with

transgenesis is being able to be specific to the extreme because- scientists can pick with greater precision the trait they want to express. The number of unwanted traits can be kept to a bare minimum. The next advantage is it is much faster, finding the trait takes only one generation compared with the numerous generations frequently needed for selective breeding, where a lot is left to chance. Another advantage of transgenesis is it is very flexible; characteristics that would usually be unavailable in some animals or plants may be achieved using transgenesis methods. (6)

I'm going to address is the biological implications that selective breeding and transgenesis have on survival of a population and evolution of a population. Selective breeding and transgenesis both have biological implications towards the survival of an organism's population. Selective breedings effect is that when you closely breed organisms together it means that that genotype of the future generations are going to be very much the same, therefore if a harmful disease comes along and is lethal to one of these organisms it is going to be lethal to all of them meaning that the this disease might wipe out the whole population. But the upside to selective breeding is that if you breed the organisms that are the biggest, strongest and most resistant to genetic diseases of that population they will tend to survive longer and therefore that organism's population will thrive. (4) Transgenesis's implications are in my opinion are better for the organism. Because in transgenesis you only transfer the gene that is desired into the organism, it means the new species can differ largely in genetic makeup still, meaning if a lethal disease came along it would only wipe out the organisms(in that new species) that were susceptible to that disease. Therefore the organisms resistant to that disease would pass on that gene, meaning that the survival of that population have a higher percentage than that of the population of the selective breeding organisms. (6) The next implication is evolution of a population for transgenesis and selective breeding. With selective breeding there is a lot of inbreeding that occurs; this means that it becomes extremely hard for those organisms to go through evolution. Because of the inbreeding a lot of the organisms become deformed or mutated because the genes inherited by both parents are too similar, therefore the evolution of that population will slowly become the death of them. (5) The effect that transgenesis has on the evolution of a population is good and bad for those organisms. It is an advantage for them because you are inserting a gene that could be beneficial for those organisms e.g. you make a certain plants pollen lethal to the insects harming them, therefore the plant will thrive and be able to go through the process of evolution without any harm towards the plant. But because the plant may become hard to die off, it could over grow and become lethal to other plants in the surrounding area killing of other organisms. (7) In conclusion both selective breeding and transgenesis have advantages and disadvantages.

	Grade Boundary: Low Merit
3.	At Merit the standard requires the student to demonstrate in-depth understanding using biological ideas to explain how humans manipulate genetic transfer (EN 3) and the biological implications of these manipulations (EN 2). The student provides evidence of in-depth understanding of biological ideas for: • selective breeding (1), which includes an explanation of test crossing • transgenesis (2), which includes an explanation of the biological techniques using restriction enzymes and ligation. The implications section provides evidence of at least two implications for each manipulation: • selective breeding on ecosystems (3) and the survival of populations (4) • transgenesis on the evolution of populations (6). Compared with the biological implications of selective breeding, those relating to transgenesis need development. To meet Merit more convincingly the explanations of the biological implications need to be supported with reasons on why they are biological implications.

Transgenesis vs. Selective Breeding is the topic in which this speech is about. Over the past there have been many different points of views and beliefs on which is better not only for the chosen individual but for the eco-system. Although transgenesis is much more accurate protests from naturalists and environmentalists have showed that it could create an evolution of the species which could be harmful towards the eco-system, selective breeding is accepted today in the modern world but it is not as accurate as transgenesis therefore the target gene may not be attained as easily. So throughout this essay I will explain both of these processes and the biological implications of each manipulation.

Selective breeding is the process of breeding plants and animals for particular traits. Selective Breeding involves a test cross method which is used to find the unknown genotypes of the organism. Using a test cross in selective breeding is when mating involves an unknown genotype e.g. homozygous dominant (AA) or heterozygous (Aa), with a known genotype the homozygous recessive. Marker Assisted Selection (MAS) is a way in which humans influence genetic transfers in selective breeding which is used for conventional breeding methods to introduce the new desirable traits into the host organism. Selective breeding is a noncontroversial way to create designer fruit/vegetables that are disease and herbicide resistant and have a more suitable flavor, texture and skin colour.

Selective breeding is also used in animals to increases their susceptibility to diseases and also increases their productivity and growth. Selective breeding on the other hand is much more eco-system friendly many humans are positive towards it because it does not involve artificial insemination into another organism it is merely the aim of attaining a desired gene through finding the trait in the certain animal and breeding it with another animal that had the necessary trait so that the off-spring will have a high chance of getting the trait through inheritance. This would keep the eco-system balanced because no new species are being formed; all that is being done is choosing the animals that have the desired trait and breeding them together. This would help towards the survival of the population because with desired trait being passed down into the off-spring through inheritance the animal would be able to live longer, produce better and its offspring would have a high chance of having the trait to, also this would not cause any drastic evolutions in the species and the global environment would not be effected.

For selective breeding purposes the homozygous dominant organism is needed. If no recessive features occur in the off spring after multiple matings then the tested organism must be homozygous and can be safely used for breeding. Selective breeding can only be used in the same species so it is very restricted.

Many people have certain opinions on the human manipulation of genetic transfer especially referring to transgenesis. People refer to scientists that genetically engineer animals as "playing god" because by doing so they could be creating new species of life. Transgenesis is when a desired trait is artificially inserted into another organism to get a required result, which can increase productivity and growth, it can make the animal immune to certain harmful diseases or if used on plants can make the plant herbicide resistant and give its fruit or vegetable a superior taste, texture and size. By doing this it is causing the eco-system to become unbalanced because this could potentially be creating new species of wild life or plant life which could result harmful to the environment. Although it may help some people such as farmers or horticulturalists it dies have a much larger effect on the total population. Yes it could

improve the organism that the desired trait is being inserted to, but it could also be harmful not just to the species but to the global environment too. Through transgenesis species would evolve and we would as humans we be unaware of the diseases that it may have, this could also cause the eco-system to become unbalanced because of the new species of life being brought into a world which is oblivious towards it.

Transgenesis is the process in which restriction enzymes are used to cut the desired gene and the plasmid, the same restriction enzyme must be used to cut both the gene and the plasmid as this will produce the same sticky ends so that they can be joined together by the DNA ligase. This is done by separating and copying the genetic material of interest using molecular cloning methods to generate a DNA sequence containing the required genetic material needed for expression, and then inserting this construct into the host organism. If genetic material from another species is added to the host, the resulting organism is called transgenic. If genetic material from the same species or a species that can naturally breed with the host is used the resulting organism is called cisgenic. Transgenesis can also be used to remove genetic material from the target organism. Transgenesis alters the genetic makeup of an organism using techniques that introduce genetic material prepared outside the organism either directly into the host or into a cell that is then fused with the host. Genetic engineering does not include traditional animal and plant breeding. Cloning and stem cell research, although not considered genetic engineering, are closely related and genetic engineering can be used within them. Synthetic biology is an emerging discipline that takes transgenesis a step further by introducing unnaturally synthesized genetic material from raw materials into an organism. First, the gene must be inserted into the genetically modified organism. Presently, most genes transferred into plants provide protection against insects or are not affected by herbicides. In animals the majority of genes used are growth hormone genes. Once chosen the genes must be isolated. This typically involves multiplying the gene using polymerase chain reaction (PCR). If the DNA sequence is known, but no copies of the gene are available, it can be artificially synthesized. Once isolated, the gene is inserted into a bacterial plasmid. The gene that's inserted into the genetically modified organism must be combined with other genetic essentials in order for it to work properly. The gene can also be modified at this stage for better expression or effectiveness. In Transgenesis only the specific trait is targeted whereas in selective breeding involves the transfer of many different genes, which can result in some of the desired traits being sacrificed due to the accuracy of the process. This is why many researchers say that transgenesis is much more sensible if you are looking for an efficient and accurate way of getting desired traits into an organism without having to cross test for the gene and then waiting to see if the off-spring receive it through inheritance.

	Grade Boundary: High Achieved
4.	At Achievement the standard requires the student to demonstrate understanding using biological ideas to describe human manipulations (EN 3) of genetic transfer and its biological implications (EN 2). The student provides sufficient descriptions of the two genetic manipulations, selective breeding (1) and transgenesis (2). There is also evidence of some explanation showing how genetic transfer is manipulated for selective breeding (3) and transgenesis (4), but insufficient at the depth required at Level 8 of the curriculum. Biological implications for the two manipulations have also been described and some attempt at linking ideas has been made: • selective breeding on genetic biodiversity (7) • transgenesis on ecosystems (5) and on the survival of populations (6). To achieve Merit more evidence of the following is required: • explanation of how genetic transfer is manipulated for selective breeding and transgenesis • explanation of at least two implications within or between each manipulation.

There are several ways people control genetic transfer in plants. In this speech I will be comparing two of these, selective breeding and Transgenesis. Selective breeding is the selection of two organisms with desirable traits for breeding. Scientists use a process called Marker Assisted Selection or MAS to help find certain desirable traits. The markers are used to quickly identify which seedlings have the desired gene. Transgenesis is when biologists transfer certain genes from one organism to another in order to gain desirable traits such as better growth, architecture, stress tolerance and nutrient content. Plants can gain these traits by cutting DNA from bacteria plasmids using restriction enzymes. The DNA containing the gene is inserted into a recombinant plasmid which is introduced into plant cells.

Selective Breeding is something that has been done for thousands of years. Today growers can gain specific traits quickly thanks to techniques such as Marker assisted selection. When MAS is used growers do not have to observe the desired trait, instead a genome is scanned analysing specific unique sequences of components in a plant's DNA to identify the desired genes. If a certain strand of DNA is associated with a trait then that strand of DNA acts as a marker. Thousands of seedling plants can then be scanned for the marker which means that it has the desired trait. This technique speeds up the breeding process as they can easily select which plants to breed. Compared to transgenesis MAS is less controversial because the plants still breed naturally through sex and no other organisms genes are involved. Transgenesis is often seen as a less ethical technique to gain triats Transgenesis uses donor DNA from another organism to gain a wider range of traits that can not be gained from their own species through selective breeding. Transgenesis uses restriction enzymes which are isolated from bacteria to precisely cut 4 to 8 base pairs from an organism with desirable traits. When this is cut a DNA fragment with two sticky ends is produced. A process called ligation is used to attach the fragment to a DNA plasmid to form a recombinant DNA (DNA that has been recombined from different organisms).The same restriction enzymes cut the fragment from the DNA so that the new fragment can be inserted into the plasmid. It is important that the same restriction enzymes are used to cut the DNA and the plasmid so that they produce the same sticky ends. The sticky ends are attached using an enzyme called DNA ligase. This new fragment now codes for a certain trait. For example a gene that codes for an insect killing toxin to be inserted into a variety of corn to make it resistant to insects.

Transgenesis can have negative effects on the balance of ecosystems. For example if transgenesis is used on a variety of corn to introduce a trait that makes the corn produce a toxin which kills insects when they eat it. The toxin may kill the insects on the corn creating increased corn growth but pollen from the corn may be carried in the air to other environments where insect populations may decrease. This could also decrease bird populations. If transgenesis were not used then the grower would likely use more insecticide having a worse effect on other environments. If selective breeding were used it would most likely not be able to produce an effective toxin because it can only gain traits from the same species. In selective breeding a lot of desirable genes may get sacrificed in the process of MAS. Transgenesis is more affective at producing a toxin because it can single out certain desirable toxin producing genes where as selective breeding involves the transferral of thousands of genes that may code for undesirable traits.

When selective breeding is used only crops with certain desirable traits are allowed to breed. This can lead to a monoculture meaning the crops are genetically identical. When the crops are genetically identical there is little genetic biodiversity and the crops can be susceptible to disease because a disease causing bacterium can change to become efficient at infecting a crop of a certain genetic variation. If the crops were genetically diverse then the disease could only infect a certain amount of the crops and would have to change again to infect other crops. Also when crops have little genetic biodiversity they can adapt as effectively to environmental changes.

7

In my opinion selective breeding is a better technique at manipulating genetic material in plants because it can efficiently control desirable traits without having to use transgenesis a process often seen as unethical.

	Grade Boundary: Low Achieved
5.	At Achievement the standard requires the student to demonstrate understanding using biological ideas to describe human manipulations (EN 3) of genetic transfer and its biological implications (EN 2). The student just provides sufficient evidence showing description of the biological ideas for the genetic manipulations of selective breeding (1) and transgenesis (2). The student has described more than one biological implication for: • transgenesis on an ecosystem in general (3) • selective breeding on the health and survival of individuals and genetic biodiversity (4, 5). Biological implications are only descriptive and consist of isolated ideas. To achieve the standard more convincingly the student needs to provide evidence in notes that support the speech showing description of the biological ideas of each genetic manipulation and the related biological implications using terms at Level 8 of the Biology curriculum.

This speech is about the biological ideas of Selective breeding and Transgenesis and the biological implications between both.

Selective Breeding is the process where plants are bred for specific traits; to do this you need pure breed animals so it will be more efficient so you won't grow an animal that doesn't obtain your desired trait, also you don't waste resources. For cross testing, while we can see the Phenotype, Genotypes are hard to determine. To determine the Genotype of animals that display desirable characteristics, you have to cross an animal that you don't know the Genotype to and a Homozygous Recessive animal of the same species. If any of the offspring contain Homozygous recessive characteristics/Phenotype, then your unknown animal is Heterozygous. (1)

4,5

The advantages of Selective Breeding is that the breeder is able to obtain the desired trait, for e.g. certain cows produce more milk on average than other cows. Disease could be prevented by detecting people/plants/animals that are genetically prone to certain hereditary diseases, and preparing for the inevitable. Also, infectious diseases can be treated by implanting genes that code for antiviral proteins specific to each antigen. The disadvantages of Selective Breeding are that the overuse of Selective Breeding can result in genetic disorders such as inbred depression. Some animals develop traits detrimental to the animal's health e.g. the cow that produces a lot of milk may have heavier udders which may be uncomfortable to the cow. Also farmers may not obtain the desired they hoped for, so they would have wasted resources trying to breed the animal with the trait to another animal. Another disadvantage is that it may change the gene pool of the animal species so that the original is being changed.

What is Transgenesis?

Transgenesis is the removal of DNA from one organism and putting it into the Genome of another. This involves Removing, Replacing and Introducing of the genes into the organisms Genome. The specific DNA is firstly gained from the supplying organism through restriction enzymes. The DNA fragments are then inserted into a cloning vector by ligation, this vector is usually some kind of bacterium- such as a Plasmid. This produces a large number of copies of the recombinant DNA. The cloned gene is located- if a Plasmid, often by testing its resistance to antibiotics. This is because the gene for antibiotic resistance in Plasmids can be used as a member for gene replacement. To ensure that the Transgenesis has been successful, electrophoresis can be used to analyse the organism's DNA once Transgenesis has been completed- tissue culture can be used to create more copies of the plant or animal tissue. (2)

The advantages of Transgenesis are that you will get the desired trait you want and additional unwanted traits can be kept to a minimum. Transgenesis can be used to fasten up maturity of some species which often take a lot of years to mature. There could also be disadvantages like the new transgenic organism having a negative effect on the ecosystem. (3)

This could influence the other plants and animals and lead to problems keeping the ecosystem balanced.

Why Transgenesis is better than Selective Breeding?

Because it is more specific, scientists can choose with greater accuracy the trait they want to establish. Unwanted traits can be kept low. It is faster, establishing the trait takes only one generation compared with the many generations often needed for traditional Selective Breeding, where much is left to chance. More flexible, traits that would otherwise be unavailable in some animals or plants may be achieved through transgenic methods.

Overall Selective Breeding and Transgenesis benefit humans by the desired traits we want from certain animals, more food, milk and other resources. Transgenesis is better than Selective Breeding due to time and accuracy.

	Grade Boundary: High Not Achieved
6.	At Achievement the standard requires the student to demonstrate understanding using biological ideas to describe human manipulations (EN 3) of genetic transfer and its biological implications (EN 2). The student provides some evidence showing description of the biological ideas for the genetic manipulations of selective breeding (2) and transgenesis (1). There is also some evidence describing implications for both manipulations: • transgenesis has been very loosely linked to ecosystems (4) and the health and survival of individuals, e.g. humans and medical benefits (3) • selective breeding on the health and survival of individuals (5) and on genetic diversity (6) To reach Achieved the student needs to provide evidence in notes that support the speech showing description of the biological ideas of each genetic manipulation and the related biological implications using terms at Level 8 of the Biology curriculum.

Kia ora, in my speech I will be looking at Transgenesis vs. selective breeding. Transgenesis is the introduction of a foreign gene into a living organism so the organism will show and pass on the genes traits whereas selective breeding is the process of breeding plants and animals for particular traits. I will look at the pros and cons of them both then giving my person opinion of them in my conclusion. (1)

Transgenesis is the introduction of a foreign gene into a living organism so the organism will show and pass on the genes traits. For example scientists in China have introduced a human gene into dairy cows to produce milk with the same properties as human breast milk. Transgenesis can be a very useful tool biological and medical research, production of pharmaceutical drugs, experimental medicine, and agriculture. I will be looking at a few of these in this speech. As scientists discover more and more about transgenesis its uses prove to be more and more useful. Scientists can now use transgenesis to help plants resistance to pests or harsh environmental conditions. They can even use it to improved product shelf life and increased nutritional value! This is good news for growers, the more healthy and better for you the crop, the more money they will be making. Bacteria were the first organisms to be modified using transgenesis. Genetically modified bacteria are now used for several purposes in medicine, including the making of insulin, a protein used to treat diabetes. The human body naturally produces insulin, it is used to break down sugars. Diabetics cannot create enough insulin to break down sugars, so being able to create large quantities of it using transgenesis is very convenient. (3)

Although transgenesis may seem like a very quick and easy way to enhance many things, there are some negative aspects to it. It is not possible to say there will be no unintended side effects. For example if you were to modify a plant so it is resistant to a particular disease-causing organism, that organism could adapt and infect other plants not previously infected. The potential of what that organism could then affect is unquantifiable! What may appear safe in the laboratory could be a genetic Pandora's Box outside of the lab. (4)

Selective breeding is the process of breeding plants and animals for particular traits. Species evolve naturally by a process of 'natural selection'. This means the species inherits and pass on the best suited genes to survive in the environment, and the weaker ones die. Selective breeding is basically doing what natural selection does, but faster and stronger. Taking two organisms and allowing them to mate, giving the offspring the best genetic traits. Selective breeding is used very widely now days, especially with house hold animals. Dogs are a very good example of this. Dogs are selectively bred for a number of reasons, such as breeding to be strong with the good tracking skills for hunting, or obedient and quick for herding or even just to be small with a silky coat for cuddling. This is very helpful for dog breeders and dog owners like. Being able to create and sell the ideal dogs, meaning more business. In some cases selectively breeding dogs is more than just a business, but a means of survival. Inuit people have benefitted by breading Husky dogs to be strong, obsidians and tolerant to harsh environment so they could tow the sleds for longer when hunting for food. Another (2)

pro of selective breeding is being able to breed animals to create the best quality of food products from the animal, such as milk or meat. There are many instances where Angus cows have been selectively bred to increase muscle mass so they can produce more meat thus making them more sellable. They have done the same with dairy cows, selectively breeding them for increased milk production. (5)

A significant con in selective breeding is the time it takes. Unlike translation, you can't just inject the gene and watch the effects, you have to wait for the offspring to be born before you can even start to see what's happened. Also when using selective breeding for a product, say fruit or vegetables, to market, they have to be proven and consistent. The only way to find this is by watching the full life of many of the plants, and this takes lots of time! In this time produces will want to keep their new strand secret from rival companies and the longer the testing to make sure the traits are permanent goes on, the more likely the secret will be exposed. Another con of selective breeding is that it reduces genetic verity. Without genetic verity species are more venerable to dieses and failures. For example English bull dogs have been selectively breed to look a certain way but a result of this is they have a great difficulty breathing. There nasal passage has been extremely restricted due to their squished up looking nose. (6)

For me, after looking at the pros and cons of both, the benefits of selective breeding outweigh the potential benefits of transgenesis breading. Since humans first stopped being hunter gathers, selective breeding has allowed the successful domestication of plants and animals. This intern has positively assisted with evaluation and development of the human race. The success of selective breeding has been proven over millennia. Transgenesis breeding is still a very new form of breeding and may in time have significant advantages for humans, but in my view it has too many risks.