



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

Exemplar for Internal Assessment Resource Biology Level 3

Resource title: Selective breeding and mammal cloning

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.

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

	<p>Grade Boundary: Low Excellence</p>
<p>1.</p>	<p>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):</p> <ul style="list-style-type: none"> • ecosystems • genetic biodiversity • health or survival of individuals • survival of populations • evolution of populations. <p>The student provides evidence that just meets the criteria for Excellence by describing the human manipulation of cloning (1), explaining how the genetic manipulation occurs (2), and describing selective breeding (3).</p> <p>The biological implications and their impact or consequences relating to each of these manipulations have also been presented:</p> <ul style="list-style-type: none"> • Cloning on the health and survival of the individual (4), supported by a good biological explanation (5) and genetic biodiversity (6) including consequences, e.g. susceptibility to disease and supported with an example (7) • Selective breeding on genetic biodiversity and the related consequences, e.g. inbreeding depression (8) and the health and survival of the individual (9). The student has also linked two implications and their consequences (10) to consider the differences between selective breeding and natural selection (11). <p>The student has made comparisons between the benefits and cost effectiveness (economical implication) of using both manipulations (12) and linked them to decreased biodiversity and survival of populations (13).</p> <p>The student could more convincingly secure this grade at Excellence by providing more supporting evidence using biological terms at Level 8 of the curriculum.</p>

1 Mammal cloning is executed through a number of techniques; all involving the transfer of genetic material with the purpose of creating an individual that is genetically identical to the individual from which the genetic information is taken. In the case of Dolly the Sheep; a technique called the 'Roslin technique' was used. The Roslin technique, developed by researchers at the Roslin institute of technology in Scotland, involves 'somatic cell nuclear transfer'. This means that a somatic cell, which is a non-reproductive living cell, was taken from the udder of a six year old Finn Dorset breed sheep, and put into a solution of nutrients. Scientists then deprived the cell of most of these nutrients so that it would remain alive, but enter into the 'dormant' stage – where cell replication no longer occurs. When the cell has reached it's dormant stage, it's nucleus is removed. The nucleus is then inserted into a 'enucleated oocyte (egg) cell'. This means that the nucleus from the udder cell is put into a reproductive cell (egg cell) of the donor sheep. This egg cell has had it's nucleus removed. Once this process has been completed both cells (the somatic cell, and the egg cell that has been transplanted with the nucleus of the somatic cell), were shocked with an electric pulse. This released a surge of energy into the cells, which allowed them to fuse into one cell. This cell then divided and developed into an embryo. The embryo was then implanted into a surrogate mother (a sheep which would carry the artificial embryo without involving any of it's own genetic information). The embryo was then delivered in the normal way. 2

4 The primary implication that became evident in Dolly the Sheep was the compromise to her individual survival. In the first instance the survival of cloned embryos such as Dolly has a very low rate. Dolly was the only embryo to survive to adulthood out of 277 trialed embryos. Dolly herself indicated many health problems, and only lived to the age of 6. This is young for sheep – who have an average lifespan of 12 years. Many of her vital organs displayed defects which were difficult to explain – including her liver, brain, and heart. She also displayed signs of premature aging before her death. These health issues are thought to be a result of a common cloning complication called 'telomere shortening'. A telomere is the compound structure at the end of a chromosome, which codes for many vital biological processes. Telomere shortening is an unexplained complication of cloning, which involves the telomeres of the chromosomes of sheep such as Dolly shrinking over time. At a certain point in Dolly these telomeres are thought to have reached a 'critical length'. This meant that they were so short, the cells in Dolly could no longer divide properly, and eventually not at all. At first this lead to tumors growing in her lungs as a result of incorrect cell division, and eventually it lead to her death. Dolly's early death which was resultant of telomere shortening is an indicator that the health or survival of cloned individuals is currently unlikely to be as good or as long as naturally created individuals. 5

3 Selective breeding is an incredibly old method of manipulating the gene pool of a population through breeding specific individuals together to produce 'favourable' traits. In the case of producing easy-care sheep, the favourable genes scientists are looking for are bare heads and legs, bare bellies, and short tails. To be able to reliably produce these favourable traits; scientists must create offspring that display dominance in all of these traits. Displaying dominance simply means the traits are shown on the phenotype of the individual – e.g. the traits are physically observable. To do this; two members of the same species are crossed together (bred to produce offspring). These two members of the same species are selected for the dominant favourable traits that they show. This cross will produce some offspring that show dominance (phenotypically) in ALL the favourable traits.

6 The other most prominent implication of cloning is that it will have a definite impact on the genetic biodiversity of populations. The biodiversity of a population refers to the amount of different genes present in the gene pool of the population. Cloning, by definition, creates genetically identical copies of a certain species of – in this case study – sheep. If cloning were to be used on a widespread scale in farming – the biodiversity of the sheep population would be virtually nil. This has significant disadvantages to the survival of the population. Without biodiversity – the population as a whole increases in susceptibility to disease. 7 An example of this can already be seen today in Cheetahs. In the Cheetah population, which has very little biodiversity, is presently declining rapidly in numbers and struggling to fight off diseases as a population. This is because their genetic makeup is so similar. This similar genetic makeup means that while in a bio diverse population some individuals would be susceptible to a disease while others are immune; in the case of the Cheetah population of one is susceptible to a disease, they are all likely to be susceptible. This means that if such a disease should hit any population without genetic biodiversity; the population would not be able to resist the disease, and it would eventually die out.

A major implication towards the genetic biodiversity of a population that is selectively bred for over multiple generations is the flow-on effect of constantly breeding for the same genes. This flow-on effect is called inbreeding depression. Inbreeding depression is an observed effect constant selective breeding has on a population. Because scientists are constantly breeding for the same traits in this breed of sheep – they are likely to 'weed out' many genes – genes that are not being consciously selected for. This will cause the gene pool of the population to significantly decrease. Scientists go to efforts to avoid inbreeding depression – however many genes that are removed from populations such as the sheep populations go un-noticed, due to their apparent insignificance. 8

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and
10 Inbreeding depression will therefore also effect the survival of the sheep population. The changing and sometimes reducing of a gene pool happens in populations naturally through normal breeding patterns – however when it occurs naturally it is in response to environmental factors changing, rather than a deliberate act by a scientist. In selective breeding some traits may be selected 'against' that are actually vital to the survival of the population – which would not happen naturally. 11 For example a gene that does not contribute toward a favourable trait in the eyes of the scientists such as a short tail may be selected against and eventually removed from the gene pool of a population. This gene, however, may have been providing immunity against a certain disease. In this case immunity against this disease would be lost. This would mean more individuals within a population would be likely to die from this disease, and the survival of the population would then be adversely affected.

Both cloning and selective breeding have easily observed advantages. In the case of Dolly the sheep – the largely successful cloning of a mammal has significant economic advantages. Animal cloning is a much more efficient way of reproducing animals – which is a definite advantage for the production of livestock for farming. More livestock will be able to be produced in a shorter time frame – producing an economic advantage. A similar thing can be said for selective breeding. In the case of the production of easy care sheep; the manipulation of genetic material for the production of easy-care sheep will in this case produce sheep which have less health complications. This will mean that care of the sheep will be more cost and time effective. 12

The disadvantages, however, are extensive for both forms of genetic manipulation; especially cloning. Both forms of manipulation cause the gene pools of populations (in this case study the sheep population) to shrink considerably. This has adverse effects on the survival of the population. These effects are more notable in cloning, however, because cloning produces genetically identical sheep. This narrows the gene population more than selecting for certain genes and allowing others to vary naturally as in selective breeding. Cloning also produces significantly more risks in terms of the survival of individuals. Although selective breeding, as talked about, may remove genes that give an individual immunity to certain diseases; complications arising from telomere shortening in mammal cloning reduce the life span and health of cloned sheep much more significantly and definitely. Telomere shortening produces life-threatening health complications that are at this stage not properly explained; therefore not preventable. For this reason cloning has many more potential disadvantages than selective breeding. 13

	<p>Grade Boundary: High Merit</p>
<p>2.</p>	<p>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).</p> <p>The student provides evidence of in-depth understanding of the concepts and processes for the human manipulations of selective breeding (1) and cloning (3). Explanations of the biology for how humans manipulate genetic transfer using selective breeding (2) and cloning (4) are also given.</p> <p>There is evidence showing explanation of at least two implications for:</p> <ul style="list-style-type: none"> • Selective breeding on genetic biodiversity (5) and the consequences, such as inbreeding and loss of alleles, and the survival and adaptability of a population (6) • Cloning on the survival and health of individuals - 'Dolly' (7), with an explanation of telomere shortening (8), genetic biodiversity (9) with related consequences (10), and on the survival of populations (11). <p>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.</p>

① Selective Breeding is the intentional breeding of organisms with desirable traits in an attempt to produce offspring with similar desirable characteristics or with improved traits

Easy Care Sheep have been selectively bred to be more productive and less labour intensive for farmers. Researchers selected traits (physical characteristics) they deemed to make sheep easier and cheaper to farm and combined these to create an easy care sheep. Desirable characteristics such as short tails, ^{and} less wool on the belly, head and legs saves farmers time and money by making the sheep easier and quicker to shear and reducing the need for ~~more~~ procedures like daggings (removing a build up of faeces on the tail), and treating flystrike.

Selective breeding is the method chosen by scientists to develop easy care sheep. It is an ancient technique, used by farmers to improve livestock well before the discovery of DNA. Selective breeding involves selecting traits you want and mating animals with those traits together, to produce more of the traits in the progeny (offspring). Some of the desirable traits, such as bare head and legs, are easily identifiable in common New Zealand breeds, however other traits were discovered by reading the scientific literature on sheep.

To determine the heritability of particular traits in sheep, scientists calculate how much is due to genetics and how much is due to environment by examining the extent to which related sheep, raised in the same environment, resemble each other in a particular characteristic. The higher the heritability, the more quickly a trait will be reproduced in subsequent generations. (Low heritability is less than 0.15, 0.15 to 0.3 is medium heritability, and over 0.3 is high heritability.)

While it is an advantage to both the easy care sheep and to humans to produce these desirable qualities, continuous in-breeding and selective breeding of particular genes runs the risk of losing some of the other genes from the gene pool of the population, which is irreversible. In the long term, Genetic Diversity is reduced.

Genetic diversity means the gene pool of a species is prepared for a wide range of scenarios such as food shortage or an epidemic of disease. Some genes in sheep may provide the individual with immunity against the disease or an ability to ~~be~~ survive on alternative food sources. Through selective breeding some of these genes may be phased out of the gene pool.

Genetic diversity plays a very important role in the survival and adaptability of a population because when a ~~population's~~ population's environment changes, slight gene variations are necessary to produce

changes in the anatomy or behaviour of the population (sheep in this case), that enables it to survive. Selective breeding leads to reduced genetic diversity, therefore less variation. Should the easy care sheep's environment change, all sheep will be affected, and if the change is deadly, then the lack of variation will lead to the death of the entire population of sheep.

Mammal Cloning is the process of creating an exact copy of a mammal, especially by way of biotechnological methods.

Dolly the Sheep was the first cloned mammal ever to be created from an adult cell. The method of cloning used to create Dolly was Somatic Cell Nuclear Transfer.

A Somatic cell is any cell in the body other than the two types of reproductive cells; sperm and egg. (Also known as germ cells.) In mammals, every somatic cell has two complete sets of chromosomes, whereas the germ cells only have one complete set. In normal sexual reproduction a germ cell from each parent combine to create an individual with genetic material from both parents. In cloning, using this technique, a cell with a complete set of genetic information is stimulated to behave like a fertilised egg cell.

Implications on Genetic Biodiversity and Survival of Populations

While it may be useful to humans to clone mammals with desirable characteristics, for both agricultural and medical reasons, the cloning of mammals greatly decreases the genetic diversity of the population. As cloning results in offspring that are genetically identical to the 'parent' sheep, all sheep will possess only those alleles present in the 'parent' sheep. All other alleles are lost. Because all sheep cloned from the same 'parent', they will all be susceptible to the same disease or environment change, and all individuals in a population of cloned sheep will be affected, even killed, by this change.

If cloning were to become common practice in sheep populations, and other mammals, then the population would be genetically identical. As well as the implications this process has on genetic biodiversity and the survival of populations, cloning by this process also affects the health and survival of individuals. Dolly died at age six, much younger than the average life expectancy (12 years). Dolly also suffered from arthritis, and was euthanised (put down) in 2003 when an animal care worker noticed Dolly was coughing and it was confirmed that she had Sheep Pulmonary Adenomatosis, which is a disease that induces tumours to grow in Sheep's lungs.

A suggested reason as to why Dolly died far too young is telomere shortening. Telomeres are at the ends of chromosomes, and as each cell replicates, they grow shorter. Dolly's telomeres were found to be about 80% of the length they should be for a sheep her age.

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	<p>Grade Boundary: Low Merit</p>
<p>3.</p>	<p>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).</p> <p>The student provides evidence of in-depth understanding of biological ideas for:</p> <ul style="list-style-type: none"> • Selective breeding (1), which includes an explanation of dominant and recessive inheritance. The concept of test crossing is identified and described (2) • Cloning, including an explanation on how humans manipulate the genetic material to carry out cloning (3). <p>The implications section shows evidence of at least two implications for both:</p> <ul style="list-style-type: none"> • Selective breeding on the health and survival of the individual (4) and the impact with an example to support this (5), and on the evolution of populations (6) • Cloning on the health and survival of the individual (7), including an explanation of telomere shortening linked to aging (8), and on the evolution of populations (9). <p>To secure the grade at Merit explanations of the biological implications could have been better supported by including more convincing reasons as to why they are biological implications and what their impacts are.</p>

Breeding "easy care sheep" is carried out by a process called "selective breeding". Selective breeding is the intentional breeding of organisms (in this case sheep) with a desirable trait/characteristic in the attempt of producing offspring with the similar ~~sheep~~ desirable characteristics as the original sheep that produced them - mating the sheep with desirable traits together to produce more of the traits in the flock.

The traits chosen for easy care sheep are bare backside, bare belly, bare head, bare legs and short tail. These are desirable traits because the sheep will be easier to maintain - they are easier to ~~shear~~ (the head/face & backside would be particularly difficult to shear)

A biological implication of selective breeding for easy care sheep is the health and survival of an individual/individuals.

In this case the use of selective breeding for easy care sheep will help increase the health & survival of the individuals.

An example of this is an individual's with less or no wool on their behind. This can increase the sheeps survival because there will be less build up of dags on/in the wool. With lots of wool on a sheeps behind there is a higher chance of

faeces getting caught and building up. A build up of faeces will attract flies - flystrike by blow flies. These will lay maggots in the sheeps fleece which if not treated will eventually cause skin damage. Thus selective breeding ~~is~~ is an advantage for easy care sheep - the individual sheep. However with little or no wool on an individual sheeps head, legs and belly the ~~sheep~~ individuals could get colder during the ~~cold~~ winter & Autumn seasons.

Another biological implication of using selective breeding to create easy care sheep is the evolution of populations. Scientists estimate that it will take between 5-7 years for ~~at~~ a flock of easy care sheep to be breed. It is also said that not all of the traits desired - short tail, less wool on belly, legs, head & behind - can be found/created on one breed of sheep.

This will make it easier to breed a flock of easy care sheep with these traits because the traits will be dominant. However the ~~the~~ bare belly trait is a recessive gene that occurs from time to time in a number of different ~~sheep~~ breeds, thus this trait is hard to locate & even harder to create a flock of. To create a flock of easy care sheep with this trait two recessive ~~sheep~~ will have to mate to create pure breed recessive offspring. Not all bare belly sheep will be purely ~~be~~ bare belly, some can carry traces of the dominant wool belly trait which can be passed on to offspring.

Dolly - the sheep was the first mammal to be cloned from an adult cell/adult DNA. Dolly was made by a process called somatic cell nuclear transfer (SCNT). During this process a cell/~~is~~ genetic material ~~is~~ was taken from the udder of a sheep (the sheep used was six years old), this cell was kept in nutritional solution ~~while other~~ the ~~egg~~ researchers then deprived the cell of ~~deprived~~ the cell of nutrients thus making it go into a sleeping state. An egg was taken from another ewe and the nucleus of the egg was removed so the sleeping cell of the first sheep could be inserted into the nucleus free egg cell. To stimulate cell division, or to wake up the sleeping cell the cells were given an electric shock. The egg cell & the other cell began to act like a fertilized egg, the cells started dividing & growing until the egg was ready to be implanted into a third ewe.

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A biological implication of using cloning to clone Dolly is the health and survival of the individual. By the use of cloning if the ~~genetic~~ ~~material~~ ~~from~~ ~~the~~ ~~donor~~ ~~sheep~~ that the genetic material - ~~egg~~ ~~came~~ ~~from~~ ~~the~~ ~~donor~~ ~~sheep~~ or cell/DNA ~~from~~ ~~the~~ ~~donor~~ ~~sheep~~ ~~had~~ any diseases then the disease would be passed on to the clone.

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With each cell replication the telomeres will grow shorter. Scientists believe cells stop replicating when the cells reach a certain length. Because Dolly had the genetic material from a sheep that was six years old there is a possibility that the length of her telomeres was influenced by the length of the donor sheep. Dolly's ~~telomeres~~ telomeres were approximately 80% of the length they should have been for a sheep her age.

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Another biological implication related to the cloning of mammals is the evolution of populations. Because humans ~~can~~ choose the traits they want the sheep to have the sheep don't get to determine what traits get carried on through generations. Dolly was cloned ~~from~~ using the genetic material from one sheep & the egg from another.

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	Grade Boundary: High Achieved
4.	<p>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).</p> <p>The student provides an adequate description of genetic manipulation for selective breeding (1). For cloning (2), a description of the purpose of this manipulation is missing. There is adequate description of how humans manipulate the genetic material to carry out cloning (3).</p> <p>Biological implications for the two manipulations have been described for:</p> <ul style="list-style-type: none"> • Selective breeding on genetic biodiversity (3), with a weak description of an impact (4) and the health and survival of the individual (5) • Cloning on genetic biodiversity (6), with a weak description on some impacts and the health and survival of the individual (7). <p>To achieve Merit more evidence of explanations are required showing:</p> <ul style="list-style-type: none"> • the biological ideas on both manipulations at Level 8 of the curriculum • at least two implications within or between selective breeding and cloning.

The way in which humans can manipulate genetic transfer is through selective breeding. Selective breeding refers to "a way of capturing a package of traits that either fancy to those traits or they are economically beneficial to you", Dr David Scobie AgResearch. A trait is simply one characteristic that an animal in this case expresses. The process is fairly simple, select the animals that have expressed the trait you want and breed them.

When selective breeding an animal there will always be biological implications. With easy care sheep the biodiversity of genetic information is affected. When two of the same animal are breed over and over the variation between the sheep would diminish. Variation is partly caused by the genes inherited while the environment has a smaller influence on the variation. Without large variation between the sheep the biodiversity is effected. This implication can make the sheep less able to be adapted to environments.

With the heritability of a trait in relation to the parents and environment means that ~~after~~ although biodiversity is not fully impacted after around 5-7 years the diversity would be substantially different.

Easy care sheep are only present because of human intervention with the technique of selective breeding. However when creating a sheep that was never truly present before raises questions of the health and survivability of the easy care sheep.

Being selectively breed to have shorter tails this means they are less likely to require chemical treatment for flystrike. By selectively breeding and eliminating these procedures which are painful for the sheep can only but improve the overall welfare. Also the easy care sheep are able to grow faster while also having improved fertility.

Along with selective breeding, one other way in which humans manipulate genetic transfer is through cloning. Most famous successful cloning was with the creation of Dolly the sheep.

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Dolly was a clone sheep the first to be created from an adult cell. To clone dolly, the team took a cell from the udder of a six year old Finn Dorset sheep. This single cell was kept in a nutritional solution of which the cell was ~~etc~~ then deprived of. This causes the DNA in that cell to go into a "sleeping" state. Then the nucleus of a sheep egg cell from another sheep was removed. This nucleus free egg cell was inserted into the "sleeping" cell. Once that step was complete an electric shock was given to the two combined cells. The electric shock caused the cells to act like a fertilised egg to which it starts to divide and grow. After a few months the egg was implanted into another sheep in which soon after Dolly was born an exact copy of the sheep from which the udder cell came from.

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When cloning an animal in this case Dolly genetic diversity comes into question. Because Dolly was genetically an exact copy many ask what implications would that have. Simply continuously cloning an animal that are genetically the same means that the only way to achieve a variation is to introduce a new breed of sheep as all will be genetically identical with a genetically identical clone the impact on the animal to adapt to everything situated around it. When Dolly was cloned the possibility of changing and manipulating selected genes is important when considering what can now be done.

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Dolly should have lived longer than she did and for this reason the survivability of cloned animals was brought into question, however not only that but ~~and~~ large groups of cloned animals could face the same fate of an early life. Many factors effect the survivability of an animal and Dolly was no different. Over an organisms life DNA deteriorates and unrepaired damage causes some diseases and if this damaged DNA is carried over then it would give the cloned animal a head start to developing a disease.

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	Grade Boundary: Low Achieved
5.	<p>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).</p> <p>The student provides the just sufficient evidence of the biological ideas for the genetic manipulations of selective breeding (2) and cloning (1).</p> <p>The student has described more than one biological implication for:</p> <ul style="list-style-type: none">• Cloning on the health and survival of individuals (3) and decreased genetic biodiversity (4)• Selective breeding on the health and survival of individuals (6) and genetic biodiversity (5). <p>The biological implications are descriptive and only consist of isolated ideas.</p> <p>To achieve the standard more convincingly the student needed to provide more evidence showing description for each genetic manipulation and the related biological implications at Level 8 of the curriculum.</p>

On 5th July 1996, Dolly the sheep was born. Dolly was the first successful mammal ever created. She was created by taking remaining mammary cells from ~~her~~ a ~~then~~ six year old Finn Dorset sheep and kept in a nutritional solution, they then deprived the cell of the nutrients which made the cell's DNA go into a "sleeping state". The nucleus of a sheep egg cell from a ~~scottish~~ blackface was then removed, then the sleeping ~~cell~~ cell was ~~then~~ inserted into the now nucleus-free egg cell. The two combined were then given an electric shock, and to the scientists surprise the combined cells acted ~~by~~ like a fertilized egg cell, and started to divide and grow, thus starting the development of dolly. The egg was then placed in a third ewe and a few months later, Dolly was born.

Dolly's mitochondrial DNA comes from the egg donor, while normally mitochondrial DNA comes from the mother. ~~which~~ means clones are not ~~be~~ carbon copies of their parents. But they have an unnatural similarity rate with them, this means they could distort the population concept. This could significantly decrease the gene pool and negatively affect the genetic biodiversity of the species.

Selective breeding, is when you get two organisms with desirable traits, and you breed them to get ~~a~~ viable organisms with the desirable traits. Easy care sheep have been selectively bred to be more productive and less labour intensive. The researchers at Ag Research have selected traits they deem to make sheep easier and cheaper to farm and combined these to make an easy care sheep. The easy care sheep have less wool in key places such as backside, belly, head and legs.

'continuous' ~~continuous~~ in-breeding or selective breeding of particular genes means that, there is a risk of inbreeding depression where because of continuous in-breeding or selective breeding the less desirable traits may be lost from the gene pool altogether which is irreversible and will negatively affect the genetic biodiversity. ~~This could be the danger~~ This means some of the possible genes for fighting disease could be phased out and the population could be destroyed.

Continuous in-breeding or selective breeding decreases the genetic biodiversity which implicates the survival of the species. ~~As~~ its continuous selective breeding occurs the ability of the species to adapt / survive decreases as in ~~the~~ ~~area~~ species there are multiple genes to ~~the~~ best fit the crises that forces the species to adapt, but with selective breeding there isn't much genetic diversity so the chances of adapting / surviving become increasingly difficult.

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	Grade Boundary: High Not Achieved
6.	<p>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).</p> <p>The student does not provide sufficient evidence describing the biological ideas for the genetic manipulation of selective breeding (1) or cloning. The student has given a description of how humans manipulate genetic material to carry out cloning (2).</p> <p>There is some evidence describing implications for:</p> <ul style="list-style-type: none">• Selective breeding on genetic biodiversity (3) and loss of variation• Cloning on the health and survival of individuals (4) and ecosystems, e.g. food chains (5). <p>To reach Achieved the student needed to provide more convincing evidence showing description of the biological ideas and implications for both manipulations at Level 8 of the curriculum.</p>

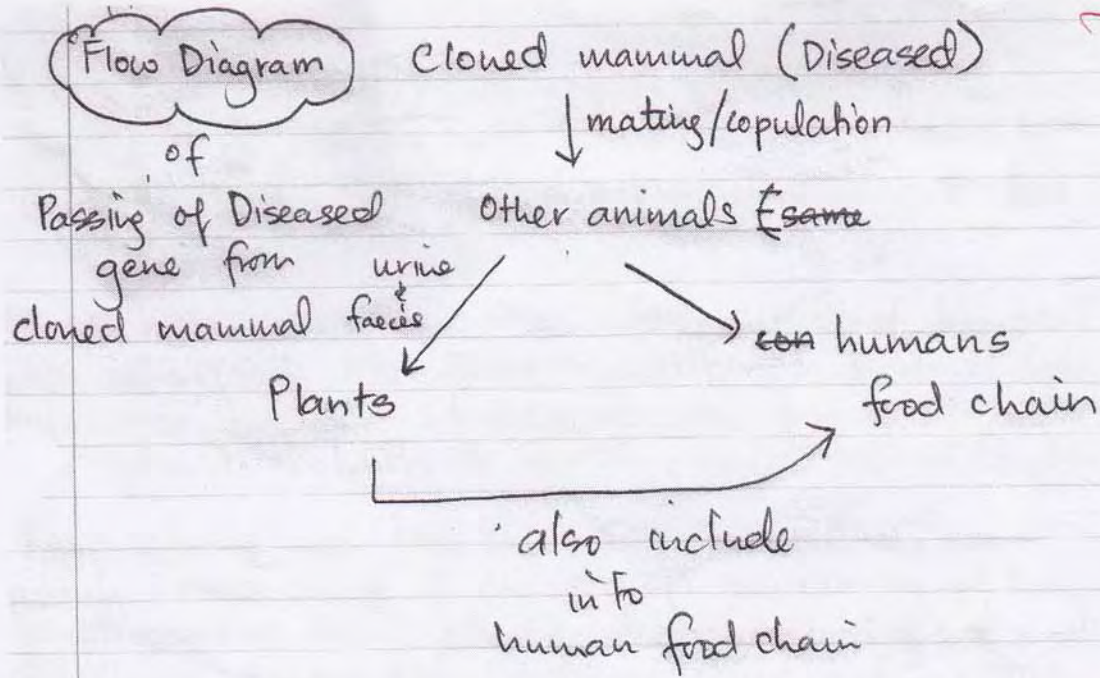
1 } Selective breeding is by far the easiest way and rather safe way to variation. It is the intentional breeding of an organism with a desirable characteristics or with improved traits. The advantage of such a breeding process is that there is a high economic gain.

3 } This method of breeding has its advantages also. There could be a massive loss of variation because it decreases the gene pool in which the animal is likely to express similar susceptibility.

2 } Dolly's cloning was time consuming and took them many research to finally attempt the cloning of Dolly. At the start of Dolly's cloning, researchers had taken a cell from a 6 year old Fin Dorset sheep and was kept in a nutritional solution. Following that, they made the DNA of the cell ~~more~~ into a sleeping stage by simply removing the cell's nutrients. They had also removed ~~the nucleus~~ from an ewe's cell and inserted it into the cell which was at sleeping state. Electro-fusion was used to allow the 2 cells to fuse with each other. Upon doing that, it was seen that the 2 cells had behaved like that of a fertilized egg. At the final stage, the fused cell ~~was~~, otherwise known as, the embryo was inserted in an ewe which was the surrogate. Months later, sheep developed and months later, Dolly the sheep was born. Dolly was found to be identical to the ewe from which the udder cell was taken from.

5 } The sheep sadly had a short life span of 7 years, she died in 2003. Her death was caused due to gene mutation in which her telomeres of her chromosomes were shortened 80% compared to the original length.

4 } Selective Breeding and mammal cloning thus have its health issues. Selectively breeding animals narrows the gene pool but it has high chance to variation. In contrast ~~with~~ to mammal cloning, it has no chance to variation because the offspring has the exact genes from the parent. In addition, a cloned mammal, has a massive chance of having diseases. Therefore, the future survival population is lessened and a cloned mammal may not be able to live long.



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