

Genetics and Heredity Document Based Questions (DBQ)

Artifact A

Selective Breeding

Selective breeding is the traditional method for improving crops and livestock, such as increasing disease resistance or milk yield.

Genetic engineering is a faster way, which transplants genes for a desired characteristic into an organism. However, genetic engineering offers many potential benefits but carries the risk of unexpected harmful effects.

Selective breeding and genetic engineering

Over the centuries humans have tried to breed better crops and livestock. Traditionally this was done by carefully choosing parents for breeding that show the required characteristics - selective breeding. More recently it's been possible to implant particular genes using genetic engineering. Both these techniques depend on there being change and variation in the genetic material – which is caused by mutations.

Mutation

Mutation means any change in the genetic material. Mutation occurs naturally. Most mutations are harmful to an individual, but occasionally a mutation can be beneficial. It's possible to speed up mutation rates artificially using radiation or chemicals. Mutations bring about changes in organisms by changing the sequence of bases in DNA. This causes a different protein to be made, or blocks the production of the protein completely.

Selective breeding

1. These are the steps in selective breeding:
2. Decide which characteristics are important
3. Choose parents that show these characteristics
4. Select the best offspring from parents to breed the next generation
5. Repeat the process continuously

Examples of selective breeding

Wheat - Producing disease-resistant wheat by crossbreeding wheat plants with disease resistance and wheat plants with a high yield.

Dairy cattle - Increasing milk yield by selecting bulls from high yield herds and breeding them with cows that have the best milk production.

Cattle breeds - Selective breeding can also be used to modify other characteristics of cattle.

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Problems with selective breeding - higher tier

Future generations of selectively bred organisms will all share very similar genes. This could make some diseases more dangerous as all the organisms would be affected. Also there's increased risk of genetic disease caused by recessive genes.

Some genes would be lost, making it more difficult to produce new varieties in the future. In scientific language this would be described as 'inbreeding can lead to a reduction in the size of the gene pool'.

http://www.bbc.co.uk/schools/gcsebitesize/science/add_gateway_pre_2011/living/genesrev2.shtml

1. What are the primary differences between selective breeding and genetic engineering? **L6-8RST1**
2. Why do people choose to selectively breed animals? **L6-8RST1**
3. How can selective breeding be used to improve the quality and availability of food sources? **L6-8RST1**
4. What is a potential downfall of selective breeding? **L6-8RST1**

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Artifact B

Genes and Heredity

Heredity is the passing of genes from one generation to the next. You inherit your parents' genes. Heredity helps to make you the person you are today: short or tall, with black hair or blond, with brown eyes or blue.

Can your genes determine whether you'll be a straight-A student or a great athlete? Heredity plays an important role, but your environment (including things like the foods you eat and the people you interact with) also influences your abilities and interests.

A person can have changes (or mutations) in a gene that can cause many issues for them. Sometimes changes cause little differences, like hair color. Other changes in genes can cause health problems.

DNA is wrapped together to form structures called chromosomes. Most cells in the human body have 23 pairs of chromosomes, making a total of 46. Individual sperm and egg cells, however, have just 23 unpaired chromosomes. You received half of your chromosomes from your mother's egg and the other half from your father's sperm cell. A male child receives an X chromosome from his mother and a Y chromosome from his father; females get an X chromosome from each parent.

Genes are sections or segments of DNA that are carried on the chromosomes and determine specific human characteristics, such as height or hair color. Because you have a pair of each chromosome, you have two copies of every gene (except for some of the genes on the X and Y chromosomes in boys, because boys have only one of each).

Some characteristics come from a single gene, whereas others come from gene combinations. Because every person has about 25,000 different genes, there is an almost endless number of possible combinations!

http://kidshealth.org/teen/your_body/health_basics/genes_genetic_disorders.html#

5. What are some of the examples of heredity from the article? **L6-8RST1**
6. What factors are responsible for whom you become? **L6-8RST1**
7. What is one of the negative aspects of heredity? **L6-8RST1**

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Biotechnology

James Watson and the late Francis Crick discovered the structure of DNA in 1953; Watson has spoken in favor of genetic engineering. Biotechnology isn't something new - selective breeding to create more useful varieties of animals and plants is a form of biotechnology that human beings have used for thousands of years.

Biotechnology includes any use of science or technology to alter the characteristics of a particular breed or animal.

Biotechnology can be good or bad for animals - and it may also produce an answer to the ethical problems of experimenting on animals.

Transgenic animals raise a particularly difficult problem.

Human problems

Newspaper articles about the ethical problems of genetically engineered animals are usually concerned about the danger these animals may pose to human beings (usually to human health), rather than any implications for the animals themselves.

Animal rights

Genetic engineering and selective breeding appear to violate animal rights, because they involve manipulating animals for human ends as if the animals were nothing more than human property, rather than treating the animals as beings of value in themselves.

Recent action to allow animals to be patented reinforces the idea of animals as human property, rather than beings in their own right.

Animal welfare

Biotechnology can be good for animals. Selective breeding and genetic engineering can benefit animals in many ways:

- Improving resistance to disease
- Breeding to remove characteristics that cause injury (e.g. selecting cattle without horns)

But biotechnology can also be bad for animals - the good effects for the breeder can be offset by painful side-effects for the animals:

- Modern pigs have been bred to grow extra fast - some breeds now grow too fast for their hearts, causing discomfort when animals are too active
- Broiler chickens are bred to grow fast - some now grow too fast for their legs

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Regulating genetic engineering

Profitability is one of the major drivers of both selective breeding and genetic engineering.

If animal welfare is not to be compromised, research must be restricted by a counter-balancing ethical principle that prevents altering animals in a way that was bad for the animal.

One writer, Bernard Rollin, suggests that a suitable rule to regulate genetic engineering would be this:

Genetically engineered animals should be no worse off than the parent stock would be if they were not so engineered.

This principle can easily be adapted to cover selective breeding.

http://www.bbc.co.uk/ethics/animals/using/biotechnology_1.shtml

8. According to the artifact, what is the ethical argument against selective breeding? **L6-8RST1**

9. Using context clues, what is the meaning of the phrase, “transgenic animals”? **L6-8RST4**

10. What is a negative aspect of animal selective breeding that affects their growth? **L6-8RST1**

11. What is the major reason why humans selectively breed animals? **L6-8RST1**

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Artifact C



<http://library.thinkquest.org/28599/heredity.htm>

12. What is the central idea that the cartoon makes about heredity and genetics? **L6-8RST1, L6-8RST7**

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Artifact D



<http://classconnection.s3.amazonaws.com/669/flashcards/1787669/jpg/heredity1346175562563.jpg>

13. Based upon the information in the cartoon, what can the reader infer about the role of heredity and genes? **L6-8RST1, L6-8RST7**

14. Based upon the sarcasm in the caption in the cartoon, what can the reader infer about nurture versus nature in the development of offspring? **L6-8RST1, L6-8RST7**