

# Back from the brink

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## Hint:

If you print out pages 2 – 8 of this document double sided there will be one section per sheet of paper.



# Back from the brink

## *Aims and objectives*



## Introduction

With the advance of genetic technology and knowledge the potential for humans to clone animals successfully is increasing. A high profile example of this is Dolly the Sheep

One application of this technology could be to bring extinct animals, such as the woolly mammoth, back to life or save endangered animals from extinction.

Is this desirable and what could the consequences be? Using discussion activities students will debate the scientific and ethical issues that face users of this technology

All the resources required to run this activity are downloadable from the Question of Taste website, they include:

1. Teacher resources
  - Aims and objectives sheet (this sheet) – Includes an introduction to the resources learning outcomes and curriculum links
  - Lesson plan – Instructions and advice on one way to use the resources
  - Background information – Includes some background information on the topic covered and links to further reading
2. Power point presentation – Can be used by teachers to introduce the topic and structure the lesson
3. Student resources
  - Animal profile cards – A selection of cards written to stimulate debate
  - Stakeholder profile cards – A selection of cards to further the debate
  - Student record sheets – Sheets for students to record their ideas

## Learning Outcomes

### Knowledge and understanding

- Students will learn what a clone is and how they are created
- Students will learn about some of the uses of cloning technology
- Students will learn about specific endangered and extinct animals (see info sheets)
- Through their own research students can learn about the different endangered animal lists

### Attitudes and values

- Through discussion of what animals they would want to clone, students will develop their understanding of the ethical and moral implications of cloning technology
- Students will think about how other people would view this technology and it's uses

### Skills

- Through group discussion students will develop their listening and talking skills
- By coming to a consensus in group decisions students will develop their ability to work in a team with others
- Students can carry out their own research on endangered or extinct animals developing time management and information skills



## National Curriculum links

### AQA

#### Biology

##### 3.5 Control in cells and in organisms

- 3.5.8 Gene cloning technologies allow study and alteration of gene function in order to better understand organism function and to design new industrial and medical processes

##### 3.7 How Science works

- 3.7.J Consider ethical issues in the treatment of humans, other organisms and the environment

### OCR

#### Biology

##### 2.3 Biodiversity and evolution

- 2.3.4 Maintaining biodiversity

##### 5.2 Biotechnology and gene technologies

- 5.2.1 - Cloning in plants and animals

#### Critical thinking

- This activity supports many areas of critical thinking syllabus including evaluation arguments, ethical reasoning and decision making

### General Studies

#### 3.4 Thinking and analytical skills

### WJEC

#### Biology

##### 5.6 - Applications of reproduction and genetics

- 5.6.A The principles involved in cloning as illustrated by: separating cells of developing animal embryos, nuclear transplants from somatic cells into egg cells

### Edexcel

#### Biology

##### Unit 2 Development, Plants and the Environment

- 2.4.17 Biodiversity and natural resources

## Introduction

Students will work in groups to rank in order of preference a selection of species that have been suggested as possible candidates for cloning. They will also consider how a variety of other stakeholders would view these cloning attempts.

Students will consider these questions using a mixture of structured group and class discussion.

## Equipment list

- Presentation
- Animals profiles, one set per group of students
- Stakeholder cards, one set per group of students
- Student record sheets, one set per group of students

## Instructions

### Introduction (10 minutes)

- Introduce the topic of cloning, a presentation is available to download
- Split the students up into groups of 5 or 6

### Task One (10 minutes)

- Give each group of students a set of the animal profile cards
- Place the cards face down on the table. Ask the students to read the cards one at a time and discuss as a group what they feel to be the pros and cons of cloning each animal
- Once they have discussed each animal they can rank them, from the one they would most like to clone to the least. Encourage the students to explain each animals position in the ranking
- As the groups are discussing the animals move between the groups helping to facilitate the discussion. There are a number of suggested questions on this sheet that may help this

### Task Two (10 minutes)

- After the cards have been ranked give each group the stakeholder cards. Ask the students to consider what the stakeholders would say about their top 3 choices
- Encourage the students to explain their choices from the point of view of the stakeholder concerned
- Record sheets are provided for the students to keep notes on, you will need one sheet for each animal considered

### Feedback (10-15 minutes)

- Go round the groups one at a time and ask them what their top 3 animals were and what the main reasons for their choices were
- Write down the key reasons that the groups give for their choices and organise into themes – possible themes could include scientific practicalities, eco-system damage, economic benefits, ethical and moral issues and aesthetic values
- Ask the students if considering the views of the stakeholders changed their own opinions

## Suggested questions

Below are a number of questions that you might find useful for facilitating/stimulating group discussion

- Would you want to clone this animal?
- Are some animals destined to become extinct no matter what we do?
- Do you think we understand enough about the complexities of animals and their habitats to be able to manage a large scale reintroduction?
- Is it our place to interfere in the natural world in this way?
- Does it make a difference if mankind caused the extinction?

## Extension activity

Students can be set the task of researching further animals which are either extinct, or currently on an endangered list. They could then compile their own profiles of the animals and consider what the pros and cons of cloning them might be.

## Clones and cloning

### Definition

A clone is: **noun:** an organism produced asexually from one ancestor to which it is genetically identical (from the OED online)

There are a number of different types of cloning. What we are talking about is organism cloning, the procedure of creating a new multi-cellular organism.

### Method

The nucleus of a body cell (not a sperm or an egg) is removed and placed into an egg cell which has had the nucleus removed. If this egg cell begins to divide normally it will be implanted into a surrogate mother and hopefully produce an offspring which will be a clone of the nucleus donor.

This clone will not be strictly identical to the donor for two reasons

- Firstly DNA mutations during development
- Secondly the mitochondrial DNA from the egg will differ from the donor

This could be particularly important in cross species cloning (where DNA from one species is inserted into the cell of another, as would be the case when cloning extinct animals) as incompatibilities between nuclear and mitochondrial DNA could lead to problems or to the death of the clones.

## Cloning extinct animals

### How can we clone extinct animals

- Frozen zoos, such as the facility at San Diego Zoo, are being used to store genetic material from endangered and extinct species
- The cloning would involve the recovery or reconstruction of functional DNA or cells from an extinct animal, either fossilised remains or in the case of recent extinctions preserved samples

### Why clone extinct animals?

Cloning of extinct or possibly endangered animals has been suggested for a number of reasons

- Cloning animals could drive a tourist industry (as seen in Jurassic Park)
- Cloning animals which have been driven to extinction by mans actions could be seen as a way of restoring the natural balance of an eco-system.
- Cloning could also be used to support and increase the populations of endangered species
- People would have the chance to appreciate many wonderful and beautiful species that are no longer alive today

### Problems of cloning extinct animals

The cloning of extinct animals will be difficult

- DNA will breakdown over time so finding ancient examples of it will not be easy.
- Even in situations which seem perfect for preservation, such as being frozen or encased in amber, cells and DNA are likely to be degraded beyond repair.
- There may also be problems with cross species compatibility. In extinct species the surrogate mother would have to be from a similar but not identical species and this could potentially lead to unforeseen complications
- Cloning from a single specimen will also be far from ideal as such a process will fail to provide a suitably large genetic population
- The offspring will also lack parents of their own species to teach them how to survive

- Many of the animals that people would like to see recreated have been extinct for thousands if not millions of years. All life on earth has evolved in a complex balance with its environment. Because of this their introduction, even into what was once their natural habitat, could have unforeseen and damaging consequences.
- The final problem with cloning extinct species is that many conservation biologists oppose it because it may divert funds away from other conservation projects while ignoring the underlying problems which led to extinction.

## Animal profile information

### Dinosaur

- Dinosaurs became extinct ~65 Ma during the Cretaceous-Tertiary extinction event, millions of years before humans evolved. The cause of this extinction was probably a combination of factors including volcanic activity, global cooling and a possible impact event
- Cloning dinosaurs would be problematic as intact DNA would be difficult to find. Even DNA preserved in amber will begin to degrade and so far attempts to isolate DNA in amber have been unsuccessful

### Pyrenean ibex

- The Pyrenean ibex is an extinct sub-species of the Spanish ibex, a type of mountain goat. The last known individual died in 2000, apparently killed by a falling tree. DNA was taken from the corpse soon after death and stored. It became the first animal to become 'un-extinct' when a clone survived for a few minutes in January 2009 before dying
- The reasons for the extinction of the species are not fully known but are thought to include loss of habitat, competition for food and poaching
- In the initial cloning attempt several hundred embryos were produced, but only one survived to birth

### Thylacine

- The thylacine, better known as the Tasmanian tiger or wolf, is an extinct Australian marsupial. It became extinct on the Australian mainland 1000s of years before the arrival of European settlers. It survived on Tasmania until 1936 when it was finally driven to extinction by a combination of competition with wild dogs introduced by European settlers, erosion of its habitat, disease and hunting
- The thylacine was the apex, or top, predator in its habitat. A bounty was placed on the animal as it was seen as a threat to livestock

### Bee

- Farmed bees are kept for the honey that they produce and to help pollinate commercial crops. Insects, mainly bees are responsible for pollinating about 33% of human food. Over the past decade many bee colonies have died out, this is called colony collapse disorder. The reason for this is unknown but if bees were to become extinct many eco-systems would collapse as pollination would stop

### Banteng

- The banteng is a species of wild cattle native to south east Asia. It is listed as endangered by the IUCN, with less than 5000 pure strain banteng left in Asia. There is however a large population in Australia where they were introduced in 1849. These herds are the largest in the world. The Australian herds are used for sports hunting and for Aboriginal subsistence hunters
- The banteng is the second endangered species to be cloned and the first to survive to more than a few weeks of age. A clone was born in April 2003 at San Diego Zoo in the US

## Neanderthal

- Neanderthals are an extinct member of the *Homo* Genus. They lived through out Europe and into the Middle East, appearing at about 200,000 years ago and becoming extinct about 30,000 years ago
- Neanderthals were almost exclusively carnivorous and would have been the top predator in their environment. Physically neanderthals were adapted for the cold climate of Pleistocene Europe.
- Recent DNA sequencing has suggested that neanderthals and modern humans were more than 99% similar with possibly as few as 3,000,000 bases different out of the 3,000,000,000 in our whole genome. This makes us more closely related to Neanderthals than chimps, our closest living relative. It is also thought that ~5% of the modern human gene pool has neanderthal contributions
- Please be aware that the neanderthal animal profile card could generate debate around the topic of race and what it means to be human. If these are not topics that you want to discuss in your group then please remove the card from the pack or be prepared to steer the debate away from this area

## Further reading

- Cloning fact sheet – human genome project  
[http://www.ornl.gov/sci/techresources/Human\\_Genome/elsi/cloning.shtml](http://www.ornl.gov/sci/techresources/Human_Genome/elsi/cloning.shtml)
- Mammoth cloning  
<http://ngm.nationalgeographic.com/print/2009/05/cloned-species/mueller-text>
- NHM – DNA in amber  
[http://www.nhm.ac.uk/resources-rx/files/12feat\\_dna\\_in\\_amber-3009.pdf](http://www.nhm.ac.uk/resources-rx/files/12feat_dna_in_amber-3009.pdf)
- San Diego Zoo's institute for conservation research  
[http://www.sandiegozoo.org/conservation/science/at\\_the\\_zoo/the\\_frozen\\_zoo/](http://www.sandiegozoo.org/conservation/science/at_the_zoo/the_frozen_zoo/)
- Why clone? – The University of Utah  
<http://learn.genetics.utah.edu/content/tech/cloning/whyclone/>
- Thylacine information  
<http://www.parks.tas.gov.au/index.aspx?base=4765>  
<http://australianmuseum.net.au/The-Thylacine>
- Banteng Information  
<http://www.arkive.org/banteng/bos-javanicus/threats-and-conservation.html>  
<http://www.smh.com.au/articles/2003/04/08/1049567684834.html>  
<http://www.advancedcell.com/press-release/collaborative-effort-yields-endangered-species-clone>
- Pyrenean ibex  
<http://www.newscientist.com/blogs/shortsharpscience/2009/02/first-animal-to-be-cloned-back.html>
- Colony collapse disorder  
<http://www.ars.usda.gov/News/docs.htm?docid=15572>
- Neanderthal  
<http://www.msnbc.msn.com/id/15732243/>  
<http://www.pubmedcentral.nih.gov/articlerender.fcgi?tool=pmcentrez&artid=1523253>