Title: Reviving Extinct Species

Author: Heather Smith

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Sentence Description: This case study is about whether we should pursue research to clone extinct animals.

Case Study:

Paleontologist Jack Horner loves dinosaurs. He also loves to share his passion with others, frequently giving lectures on paleontology. Jack Horner also has an unusual dream: to walk on stage leading a dinosaur on a leash. He will turn to his audience and say, "Can anyone here tell me what this is?" (Horner and Gorman 53)

"It's small," Horner explains, "but bigger than a chicken. Let's say it's the size of a turkey, one day maybe even the size of an emu. . . Instead of a lecture, this would be a public science class with questions and challenges about how it was done, what its skin feels like, does it have teeth, what does it eat . . . That would be the most satisfying lecture I could possibly give." (Horner and Gorman 53)

Horner's dream may not be as farfetched as it might sound. Scientists are working on a number of ways to revive extinct species; not just dinosaurs, which have been extinct for 65 million years, but also species which have disappeared more recently, such as the wooly mammoth and the thylacine (Tasmanian tiger). Humans definitely did not cause the extinction of the dinosaurs, but we may have contributed to the extinction of mammoths through hunting, 4000 or more years ago. Humans definitely hunted the thylacine to extinction. Thylacines were marsupial carnivores that lived on an island off the coast of Australia. They disappeared in 1936.

Scientists have long been intrigued with the idea of reviving vanished species. For instance, the Heck brothers in Germany led a program during the early 1900s trying to breed domestic cattle back into aurochs. Aurochs were the original animal, now extinct, from which cattle were first domesticated through artificial selection. Their idea is not as outlandish as it might sound. When left feral (wild) for generations, many domestic animals such as dogs, pigs, and horses revert back to their ancestral characteristics.

Now scientists are interested in taking this idea to another level. Some molecular biologists are trying to recover DNA from extinct specimens such as mammoths or thylacines so they can be cloned. You may have seen this same idea used in the fictional movie *Jurassic Park*, in which dinosaur DNA is recovered from blood in the gut of a mosquito preserved in amber. Scientists extracted DNA from mammoths preserved in ice or permafrost. DNA has also been recovered from thylacines preserved in alcohol in museum collections.

DNA breaks down over time, however. DNA has been successfully extracted from thylacine and mammoth specimens, but the helix structure is broken apart into pieces. Specimens can also be contaminated with DNA from other organisms, such as bacteria or fungi. Before cloning can be successful, the DNA would need to be reconstructed. As you may recall from our genetics unit, cloning is difficult anyway. DNA from the original organism must be placed in an egg cell, which is induced to divide. Attempts are often unsuccessful, and the cloned organism often does not survive until birth, or suffers from health problems. Also, the cloned specimen (in the case of mammals, at least) would need to be implanted into the uterus of a surrogate mother. If the species is extinct, what can be used as a surrogate?

Horner and his colleguaes, who study dinosaurs, are attempting to resurrect the species using a different method: genetic engineering. We don't have a good source of dinosaur DNA, so Horner is starting with chickens, which are a descendent of dinosaurs, and working backward. He hopes that by altering the DNA of a chicken embryo, and altering the expression of the chicken's genes, he can cause dinosaur traits to be expressed once again. It is known from looking at dinosaur proteins that dinosaur DNA was very similar to chickens'; they share many of the same genes. However, in chickens, certain genes do not turn on during development in the same way, and so the chicken does not grow a tail, teeth, or fingers. Scientists have now successfully manipulated the gene expression in chicken embryos so that the chickens grew tails. However, these chicks did not survive until hatching. Further experiments may someday lead to the expression of more dinosaur traits in chickens.

Ethical Question: Scientists cannot yet bring back dinosaurs, mammoths, or thylacines. However, we are getting closer to a point where such things may be possible. Should this research be pursued?

Guiding Questions:

1. What is your gut reaction to the idea of resurrecting extinct animals?
2. What would be the value (scientific or otherwise) of resurrecting extinct species? (For instance, what knowledge could scientists gain from having actual dinosaurs to study?)
3. Do humans have a responsibility to bring back species that we have caused to go extinct?
4. Should resources (time, money, & brainpower) be allocated for these projects?
5. Where and how would such resurrected species live? What would be the animals' quality of life? Mammoths, for instance, were thought to be highly social animals that lived in herds.

Teacher Resources / Background

Ethical Arguments

Ethical principle	Pro (Yes)	Con (No)
Respect for Persons / Autonomy	If scientists have the money and funding, and the ability to do this type of cloning, they should be able to.	• Natural habitat may no longer exist; animals couldn't live naturally, so we may be doing something just for our entertainment, but nothing that will respect the animals.
Maximize Benefits/ Minimize Harms	• Scientists could learn from directly observing species and may find benefits that could help humans (many medicines are from living things) and improve biodiversity. • Another benefit is that the public might be exicted to see and learn about extinct species, and therefore maybe preserve more species.	• Technology imperfect: many animal subjects could die or suffer health problems which is a harm • Could be considered a misallocation of money, time, and brainpower when there are other less frivolous needs such as working on disease or hunger. • Herd animals could suffer from isolation if few individuals were made • Resurrected species could harm impact the environment in unpredictable ways if released or escape
Justice	• Some species were brought to extinction by human activities before we knew hot our actions affected them. We could bring these species back	
Other Perspectives	•	• Cloning and genetic engineering could be considered unnatural (by some religious groups, for instance) (Moral Rights/ Duties)

Background – Extra Information for Teachers

This case could be presented in a number of units, including genetics, ecology, and evolution. I plan to use it as part of an evolution unit that follows genetics, to supplement how DNA similarities inform analysis of evolutionary relatedness. Students will already be familiar with DNA, cloning, and protein synthesis. It might also be helpful to have a background in the genetic engineering / cloning and basic reproduction and development.

References

Discovery Education (2004). Cloning and the Tasmanian Tiger. Science Investigations: Life Science: Investigating Cells and Genetics. Accessed 15 July 2009 from: http://streaming.discoveryeducation.com/

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Mueller, T. (2009 May). Recipe for a Resurrection. *National Geographic:* 52-55.