Cloning Wild Sheep

Objectives:
Students will learn about recent cloning activity regarding sheep and the implications involved, both positive and negative. Students will then write a persuasive essay to answer the question "Should humans clone wild sheep to make hybrid sheep."

Grade level: 5th- High School
Duration: A few days
Setting: indoors

Common Core State Standards:
CCSS.ELA-Literacy.W.5.1
Write opinion pieces on topics or texts, supporting a point of view with reasons and information.
CCSS.ELA-Literacy.W.6.1
CCSS.ELA-Literacy.W.7.1
CCSS.ELA-Literacy.W.8.1
Write arguments to support claims with clear reasons and relevant evidence.
CCSS.ELA-Literacy.W9-10.1
CCSS.ELA-Literacy.W.11-12.1
Write arguments to supports claims in an analysis of substantive topics or texts, using valid reasoning and relevant and sufficient evidence.

Background:

The cloning process, in its simplest form, involves producing individuals or cells with identical DNA, either naturally or artificially. In other words, they share almost identical DNA due to a single embryo splitting in two. However, as we very much know today, even two identical twins are not completely the same. Cloning, in fact, is a natural form of reproduction used by plants, fungi and bacteria that has enabled life forms to spread for hundreds of millions of years. In contrast, scientists have been able to tap into this process to artificially create clones. There are three different types of artificial cloning:

- **Gene cloning:** This type involves creating copies of genes or DNA segments.
- **Reproductive cloning:** This type involves making duplicates of whole animals.
- **Therapeutic cloning:** This type involves creating embryonic stem cells.

In 2024, a Montana man pleaded guilty to two felony wildlife crimes involving cloning illegally imported sheep parts from Asia to create a massive hybrid sheep.

This raises a variety of questions, even if done legally. Can cloning help with animals, such as sheep, where populations are low? Should cloning be involved with creating a more massive, or even "better" species that wouldn't be impacted as much by current diseases?

The Wild Sheep Foundation, based on its mission, has the following stance on the issue of cloning hybrid species as it relates to the article of the Montana man cloning hybrid sheep, yet this activity for students is to engage them into deep thinking of such concepts and to form their own opinion: "As the world's preeminent wild sheep conservation organization with the finest and most mission-driven network of chapters and affiliates, Wild Sheep Foundation (WSF) is sickened by this abhorrent effort to corrupt…the finest and most regal creations, the wild sheep…" -stated by WSF's President and CEO Gray N. Thornton in March 2024.

Materials:

- Article titled *Montana Man Pleads Guilty to Creating Massive Franken-Sheep with Cloned Animal Parts*
- *The History of Cloning* background
- Computers for research
- Possible article *Why Conservation Cloning Won't Save Endangered Species*

- Possible websites:
    - https://learn.genetics.utah.edu/content/cloning/whyclone
    - https://www.amnh.org/explore/ology/earth/ask-a-scientist-about-our-environment/should-we-clone-endangered-animals

Procedures:

1. Introduce the topic of cloning, perhaps through the article *Montana Man Pleads Guilty to Creating Massive Franken-Sheep with Cloned Animal Parts.* The teacher may want to give a short history of cloning by using *A Short History of Cloning*.
2. Pose the questions such as:
    - Could cloning wild sheep be beneficial? How?
    - Could cloning of wild sheep be harmful? How?
3. Brainstorm a list of ideas with the class on possibly ways cloning may beneficial or harmful.
4. Introduce the task of researching the topic of cloning and apply it to wild sheep. Students will research at least three credible sources to help form an opinion that would have evidence to back up the claim. Allow students time to research.
5. Students use their information to write a persuasive essay about cloning of wild sheep. They may take two stances:
    - Wild sheep should be cloned.
    - Wild sheep should not be cloned.

Assessment:

The edited essay is assessed based on the ability to form a claim (opinion) and back it up with evidence and reasoning. Based on the grade level, citing sources could occur.

Montana Man Pleads Guilty to Creating Massive Franken-Sheep With Cloned Animal Parts

Matt Novak

March 12, 2024

An 80-year-old man in Montana pleaded guilty Tuesday to two felony wildlife crimes involving his plan to let paying customers hunt sheep on private ranches. But these weren't just any old sheep. They were "massive hybrid sheep" created by illegally importing animal parts from central Asia, cloning the sheep, and then breeding an enormous hybrid species.

Arthur "Jack" Schubarth, 80, owns and operates the 215-acre "alternative livestock" ranch in Vaughn, Montana where he started this operation in 2013, according to a press release from the U.S. Department of Justice. Alternative livestock includes hybrids of mountain sheep, mountain goats, and other large mammals which are often used for trophy hunting by wealthy people.

An unnamed accomplice of Schubart kicked off the decade-long scheme by illegally bringing biological tissue from a Marco Polo sheep, the largest sheep in the world, from Kyrgyzstan into the U.S. in 2013, according to prosecutors.

How big are these sheep? An average male can weigh over 300 pounds with horns over 5 feet wide, giving them the largest sheep horns on the planet. The sheep are endangered and protected by both international treaties and U.S. law. Montana also forbids the import of these foreign sheep or their parts in an effort to protect local American sheep from disease.

Once Schubart had smuggled his sheep parts into the U.S., he sent them to an unnamed lab which created 165 cloned embryos, according to the DOJ.

"Schubarth then implanted the embryos in ewes on his ranch, resulting in a single, pure genetic male Marco Polo argali that he named 'Montana Mountain King' or MMK," federal authorities wrote in a press release.

By the time Schubart had his Montana Mountain King he used the cloned sheep's semen to artificially impregnate female sheep, creating hybrid animals. The goal, as the DOJ explains it, was to create these massive new sheep that could then be used for sports hunting on large ranches. Schubart also forged veterinarian inspection certificates to transport the new hybrid sheep under false pretenses, and sometimes even sold semen from his Montana Mountain King to other breeders in the U.S.

Schubart sent 15 artificially inseminated sheep to Minnesota in 2018 and sold 37 straws of Montana Mountain King's semen to someone in Texas, according to an indictment filed last month. Schubart also offered to sell an offspring of the Montana Mountain King, dubbed the Montana Black Magic, to someone in Texas for $10,000.

Discussions between Schubart and an unnamed person apparently included what to call this new breed of sheep they were creating. The other person said another co-conspirator had suggested the name "Black Argali," though noting "we can't," presumably because it would give away the fact that these sheep were descended from the argali species.

Schubart pleaded guilty to violating the Lacey Act, and conspiracy to violate the Lacey Act, which makes it a crime to acquire, transport or sell wildlife in contravention of federal law.

"This was an audacious scheme to create massive hybrid sheep species to be sold and hunted as trophies," assistant Attorney General Todd Kim from the Justice Department's Environment and Natural Resources Division said in a press release.

"In pursuit of this scheme, Schubarth violated international law and the Lacey Act, both of which protect the viability and health of native populations of animals," Kim continued.

Schubart conspired with at least five other people who are not named in the indictment. Schubarth faces up to five years in prison and a fine of up to $250,000 and is scheduled to be sentenced by Chief U.S. District Court Judge Brian M. Morris for the District of Montana in July.

Montana Fish Wildlife and Parks, Facebook/Jack Schubarth

The History of Cloning

Lost in the midst of all the buzz about cloning is the fact that cloning is nothing new: its rich scientific history spans more than 100 years. The landmark examples below will take you on a journey through time, where you can learn more about the history of cloning.

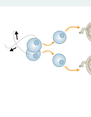
1885 - First-ever demonstration of artificial embryo twinning

Sea urchin

Hans Adolf Eduard Driesch

The sea urchin is a relatively simple organism that is useful for studying development. Driesch showed that by merely shaking two-celled sea urchin embryos, it was possible to separate the cells. Once separated, each cell grew into a complete sea urchin.

This experiment showed that each cell in the early embryo has its own complete set of genetic instructions and can grow into a full organism.



1902 - Artificial embryo twinning in a vertebrate

Salamander

Hans Spemann

Spemann's first challenge was to figure out how to split the two cells of an embryo much stickier than sea urchin cells. Spemann fashioned a tiny noose from a strand of baby hair and tightened it between two cells of a salamander embryo until they separated. Each cell grew into an adult salamander. Spemann also tried to divide more advanced salamander embryos using this method, but he found that cells from these embryos weren't as successful at developing into adult salamanders.

This experiment showed that embryos from a more-complex animal can also be "twinned" to form multiple identical organisms—but only up to a certain stage in development.

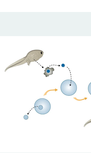
1928 - The cell nucleus controls embryonic development

Salamander

Hans Spemann

Again using a strand of baby hair tied into a noose, Spemann temporarily squeezed a fertilized salamander egg to push the nucleus to one side of the cytoplasm. The egg divided into cells—but only on the side with the nucleus. After four cell divisions, which made 16 cells, Spemann loosened the noose, letting the nucleus from one of the cells slide back into the non-dividing side of the egg. He used the noose to separate this "new" cell from the rest of the embryo. The single cell grew into a new salamander embryo, as did the remaining cells that were separated.

Essentially the first instance of nuclear transfer, this experiment showed that the nucleus from an early embryonic cell directs the complete growth of a salamander, effectively substituting for the nucleus in a fertilized egg.



1952 - First successful nuclear transfer

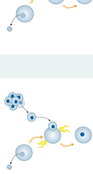
Frog

Robert Briggs and Thomas King

Briggs and King transferred the nucleus from an early tadpole embryo into an enucleated frog egg (a frog egg from which the nucleus had been removed). The resulting cell developed into a tadpole.

The scientists created many normal tadpole clones using nuclei from early embryos. But just like Spemann's salamander experiments, cloning was less successful with donor nuclei from more advanced embryos: the few tadpole clones that did survive grew abnormally.

Most importantly, this experiment showed that nuclear transfer was a viable cloning technique. It also reinforced two earlier observations. First, the nucleus directs cell growth and, ultimately, an organism's development. Second, embryonic cells early in development are better for cloning than cells at later stages.



1958 - Nuclear transfer from a differentiated cell

Frog

John Gurdon

Gurdon transplanted the nucleus of a tadpole intestinal cell into an enucleated frog egg. In this way, he created tadpoles that were genetically identical to the one from which the intestinal cell was taken.

This experiment showed that, despite previous failures, nuclei from somatic cells in a fully developed animal could be used for cloning. Importantly, it suggested that cells retain all of their genetic material even as they divide and differentiate (although some wondered if the donor DNA came from a stem cell, which can differentiate into multiple types of cells).

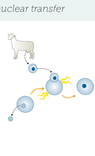
1975 - First mammalian embryo created by nuclear transfer

Rabbit

J. Derek Bromhall

Mammalian egg cells are much smaller than those of frogs or salamanders, so they are harder to manipulate. Using a glass pipette as a tiny straw, Bromhall transferred the nucleus from a rabbit embryo cell into an enucleated rabbit egg cell. He considered the procedure a success when a morula, or advanced embryo, developed after a couple of days.

This experiment showed that mammalian embryos could be created by nuclear transfer. To show that the embryos could continue developing, Bromhall would have had to place them into a mother rabbit's womb. He never did this experiment.



1984 - First mammal created by nuclear transfer

Sheep

Steen Willadsen

Willadsen used a chemical process to separated one cell from an 8-cell lamb embryo. The he used a small electrical shock to fuse it to an enucleated egg cell. As luck would have it, the new cell started dividing.

By this time, in vitro fertilization techniques had been developed, and they had been used successfully to help couples have babies. So after a few days, Willadsen placed the lamb embryos into the womb of surrogate mother sheep. The result was the birth of three live lambs.

This experiment showed that it was possible to clone a mammal by nuclear transfer—and that the clone could fully develop. Even though the donor nuclei came from early embryonic cells, the experiment was considered a great success.

1987 - Nuclear transfer from embryonic cell

Cow

Neal First, Randal Prather, and Willard Eyestone

Using methods very similar to those used by Willadsen on sheep, First, Prather, and Eyestone produced two cloned calves. Their names were Fusion and Copy.

This experiment added cows to the list of mammals that could be cloned by nuclear transfer. Still, mammalian cloning was limited to using embryonic cells as nuclear donors. Cloning using nuclei from differentiated adult somatic cells still wasn't thought possible.

1996 - Nuclear transfer from laboratory cells

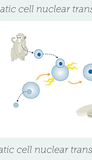
Sheep

Ian Wilmut and Keith Campbell

All previous cloning experiments used donor nuclei from cells in early embryos. In this experiment, the donor nuclei came from a slightly different source: cultured sheep cells, which were kept alive in the laboratory.

Wilmut and Campbell transferred the nuclei from cultured cells into enucleated sheep egg cells. The lambs born from this procedure were named Megan and Morag.

This experiment showed that cultured cells can supply donor nuclei for cloning by nuclear transfer. Because scientists had already learned how to transfer genes into cultured cells, this experiment showed that it might be possible to use such modified cells to create transgenic animals—such as cows that could make insulin for diabetics in their milk.



1996 - Dolly: First mammal created by somatic cell nuclear transfer

Sheep

Ian Wilmut and Keith Campbell

In this landmark experiment, Wilmut and Campbell created a lamb by transferring the nucleus from an adult sheep's udder cell into an enucleated egg. Never before had a mammal been cloned from an adult somatic cell. What was the big deal?

Every cell's nucleus contains a complete set of genetic information. However, while embryonic cells are ready to activate any gene, differentiated adult cells have shut down the genes that they don't need for their specific functions. When an adult cell nucleus is used as a donor, its genetic information must be reset to an embryonic state. Often the resetting process is incomplete, and the embryos fail to develop.

Of 277 attempts, only one produced an embryo that was carried to term in a surrogate mother. This famous lamb, named Dolly, brought cloning into the limelight. Her arrival started conversations about the implications of cloning, bringing controversies over human cloning and stem cell research into the public eye.

1997 - First primate created by embryonic cell nuclear transfer

Rhesus monkey

Li Meng, John Ely, Richard Stouffer, and Don Wolf

Primates are good models for studying human disorders. Cloning identical primates would decrease the genetic variation of research animals, and therefore the number of animals need in research studies.

Similar to previous cloning experiments, Wolf's team of scientists fused early-stage embryonic cells with enucleated monkey egg cells using a small electrical shock. The resulting embryos were then implanted into surrogate mothers. Out of 29 cloned embryos, two monkeys were born. One was a female named Neti, and the other was a male named Ditto.

This experiment showed that primates, humans' closest relatives, can be cloned.

1997 - Nuclear transfer from genetically engineered laboratory cells

Sheep

Angelika Schnieke, Keith Campbell, Ian Wilmut

This experiment was an exciting combination of findings from earlier work. Campbell and Wilmut had already created a clone using the nucleus of a cultured cell. This time, the researchers introduced the human Factor IX ("factor nine") gene into the genome of sheep skin cells grown in a laboratory dish. Factor IX codes for a protein that helps blood clot, and it's used to treat hemophilia, a genetic disorder where blood doesn't form proper clots.

To create the transgenic sheep, the scientists performed nuclear transfer using donor DNA from the cultured transgenic cells. The result was Polly, a sheep that produced Factor IX protein in her milk.

This experiment showed that sheep could be engineered to make therapeutic and other useful proteins in their milk, highlighting the potential medical and commercial uses for cloning.

1998-1999 - More mammals cloned by somatic cell nuclear transfer

Mice, cows, and goats

Multiple groups

After the successes leading up to Dolly and Polly, other scientists wanted to see if similar techniques could be used to clone other mammalian species. Before long, several more animals had been successfully cloned. Among them were transgenic animals, clones made from fetal and adult cells, and a male mouse; all previous clones had been female.

2001 - Endangered animals cloned by somatic cell nuclear transfer

Gaur and Mouflon

Multiple groups

As the list of successfully cloned animals grew, scientists began to explore cloning as a way to create animals belonging to endangered or extinct species. A challenge to cloning endangered and extinct species is finding closely related animals to serve as egg donors and surrogates. The gaur and mouflon were chosen in part because they are close relatives of domestic cattle and sheep, respectively.

In 2009, using goast as egg donors and surrogates, another group of researchers cloned the first extinct animal, a Spanish mountain goat called the bucardo. Sadly, the one kid that survived gestation died soon after birth due to a lung defect.

2007 - Primate embryonic stem cells created by somatic cell nuclear transfer

Rhesus monkey

Shoukhrat Mitalipov and colleagues

Researchers took a cell from an adult monkey and fused it with an enucleated egg cell. The embryo was allowed to develop for a time, then its cells were grown in a culture dish. These cells, from an embryo, can differentiate to form any cell type, are called embryonic stem cells.

This experiment showed that nuclear transfer in a primate, which researchers had tried for years without success, was possible. It opened the door to the possibility of human therapeutic cloning: creating individual-specific stem cells that could be used to treat or study diseases.

2013 - Human embryonic stem cells created by somatic cell nuclear transfer

Human

Shoukhrat Mitalipov and colleagues

Overcoming decades of technical challenges, Mitalipov and colleagues were the first to use somatic cell nuclear transfer to create a human embryo that could be used as a source of embryonic stem cells. The resulting stem cell lines were specific to the patient they came from, a baby with a rare genetic disorder.

In this experiment, researchers took a skin cell from the patient and fused it with a donated egg cell. Key to the success of the experiment were modifications to the culture liquid in which the procedure was done and to the series of electrical pulses used to stimulate the egg to begin dividing.

Following the cloning controversy of 2004-2005, in which South Korean scientists falsely claimed to have used somatic cell nuclear transfer to create embryonic stem cell lines, the scientific community demanded much stronger evidence that the procedure had actually been successful.

Why Conservation Cloning Won't Save Endangered Species

In a recent feature article, Tibbetts (2022) highlighted the first cloning of an endangered species. A cloned black-footed ferret (*Mustela nigripes*), one of the rarest mammals on Earth, was produced and integrated into the captive-breeding program for the species. The article focused on the question of whether "scientists [should] genetically rewire nature" to save endangered species, but it did not address the important question of whether conservation cloning can help to restore endangered species in the wild.

Elizabeth Ann, the black-footed ferret cloned from cells of a female that died 35 years prior, has brought excitement that her progeny could increase the diversity of a species recovery program based on just seven genetic founders. But let us look to the future of Elizabeth Ann and her progeny. A lack of genetic diversity is a concern for black-footed ferrets, but not a primary threat. Rather, the recent spread of an introduced disease, sylvatic plague (*Yersinia pestis*), and a lack of suitable habitat are the primary threats to ferrets in the wild (Jachowski 2014). Plague decimates wild black-footed ferret populations, leading to current efforts to genetically engineer ferrets to have inheritable immunity to the disease. Given that populations of black-footed ferrets only exist on prairie dog (*Cynomys* sp.) colonies, which are also highly vulnerable to plague, similar technology will likely have to be applied to prairie dogs as well. But poisoning by people, not disease, caused a more than 95% decline in prairie dog distribution over the past century. Large-scale poisoning continues to this day, and in combination with the impact of plague, it has forced biologists to release ferrets onto smaller and smaller parcels of habitat that have little chance of maintaining self-sustaining ferret populations. So even if we have genetically engineered, disease-resistant ferrets and prairie dogs, where will we put them?

Beyond the black-footed ferret, data suggest that habitat loss and human–wildlife conflict are typically the leading threats to most endangered terrestrial wildlife species globally (Munstermann et al. 2022). The endangered Przewalski's horse (*Equus przewalskii*), which was recently cloned, is subject to these threats, and they would similarly limit the potential return to the wild of the passenger pigeon (*Ectopistes migratorius)*, the thylacine (*Thylacinus cynocephalus*), and the woolly mammoth (*Mammuthus primigenius*), which are the focus of current cloning efforts. Therefore, although conservation cloning provides a new and potentially valuable tool to help restore endangered wildlife, in the fog of excitement surrounding this new tool, we must maintain a strong focus on addressing the issues that cause most species to become endangered or extinct in the first place—habitat loss and human–wildlife conflict.

What is clear is that conservation cloning alone cannot save endangered species. We need to match the ambitious work done to recreate and manipulate species with creative and well-supported efforts to address the sociopolitical and economic obstacles to making suitable habitat available for these species. Only when we restore and secure adequate habitat and reduce the potential for human–wildlife conflict will these species ever be recovered in the wild.

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