Cloned horses could offer insight into DNA possibilities

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Before the show-jumping champion Gem Twist died in 2006, his New Jersey owners paid to have a flap of his skin frozen -- hoping to carry something of his prodigious talent into the future.

Veterinary scientists later pulled those skin cells from the freezer and used them to clone a new horse, now a healthy, spirited 5-month-old named Gemini.

As a clone, Gemini carries the same genetic code as Gem Twist, who won Olympic medals and other high honors over his 27-year life. Today, the question is: Will Gemini inherit Gem Twist's exceptional grace, daring and strength?

Ever since the news broke in 1997 about the cloning of Dolly the sheep, pundits have speculated on the possibility of replicating Michael Jordan's jump shot, Babe Ruth's batting power, or Mikhail Baryshnikov's grand jete.

Now, the first cloned athletes are growing up -- and while none are human, they still may show how far DNA can go in endowing extraordinary talents.

In the past three years, veterinary scientists have cloned about 20 horses. Though the ruling body of thoroughbred racing forbids cloned animals, no such rules exist for show jumpers such as Gem Twist. Cloning is also allowed for rodeo horses.

Scientists and horse breeders alike are eager to see how much the clones mirror their originals. "With horses, we've got a really complex set of things in terms of both behavior and athletic ability that we're going to be able to compare," said Katrin Hinrichs, a veterinary biologist at Texas A&M University.

Gemini is brown, but his owner, Mary Chapot of Chado Farm in Neshanic Station, N.J., says Gem Twist was born this color before his coat changed to a fairy-tale whitish gray. She isn't expecting the clone to equal Gem Twist, who bore three different riders to victory in Grand Prix championships, was named best horse in the 1990 World Equestrian Games, and helped score two silver medals in the 1988 Seoul Olympics.

Gemini is destined to lead a different life -- as a stud, passing on his genes (and Gem Twist's). Reproduction was one thing Gem Twist couldn't do, since he was castrated early in life to make him easier to handle.

Used in this way, cloning will increase the gene pool, reviving otherwise lost genes.

Some have suggested that racing star Barbaro should have been cloned, because he never got the chance to reproduce.

Gem Twist was bred from a thoroughbred racehorse and a jumping champion at Chado Farm. Soon he began winning national competitions in show jumping -- a sport that requires the horse and rider to negotiate a complex obstacle course. Competitors are marked down if they hit hurdles or refuse to jump.

"He was a tremendous athlete," Chapot said. A great jumping horse has to have the right level of bravery, she said. If he's too brave, he makes mistakes, and if he's too fearful, he refuses to jump at all.

Chapot said she was approached in the 1990s by a representative of the French company Cryozootech, who eventually persuaded her to freeze tissue from Gem Twist, thus preserving the option of cloning him.

The tissue stayed frozen as scientists refined the techniques for horse cloning. The first horse was cloned by an Italian scientist in 2003 -- a process that took 17 embryos to create one foal.

Since then, Texas A&M's Hinrichs said, she's gotten about a third of her embryos to come to term.

To clone an adult animal, scientists need to get an adult cell to start developing as if it's a fertilized egg.

To create Dolly, researchers took an egg from a sheep and removed the genetic material. Then they used an electric pulse to fuse that egg with a cell from an adult sheep's udder.

For horses, scientists generally use cells from the connective tissue beneath the skin. Hinrichs said that instead of fusing them with electricity, she injects the adult cell into the egg, which has been emptied of its own genetic material. That egg then grows into an embryo in a dish before it's implanted into the uterus of a surrogate mare.

In all cloned animals, defects appear to be more common than among the naturally conceived. Cloned foals are likelier to be weak or have crooked legs, Hinrichs said.

Gem Twist and most other prominent horses are cloned by the commercial firm ViaGen, based in Austin, Texas, which charges $150,000 per animal.

Before the Gem Twist project, another equine celebrity was cloned -- a

renowned rodeo barrel racer named Scamper. Riding Scamper, New Mexico cowgirl Charmayne James won 10 world championships.

"Once you've been on a great horse like that -- the way they move and the intelligence -- you strive to find that again," James said. Scamper was living in obscurity as a working horse in a feedlot before James, then a teenager, started riding him and discovered his talent.

The clone, named Clayton, is now 2 and apparently healthy. "Clayton is a very confident horse," James said. They sound alike and look alike, and both horses have a sensitive spot behind their ears.

James isn't planning to extend her riding career with Clayton, though she's curious about his performance. He'll be used to breed Scamper's genes, which would have hit a dead end with Scamper's early castration. His stud fee: $4,000.

As a past champion, James is philosophical about the elusiveness of victory. "You might have the greatest horse or the greatest football team, and if it's not your time to win, you're not going to win."

ViaGen biologist Shawn Walker said the company doesn't promise to reproduce exceptional horse talents. But because the clones carry the same DNA, they are just as valuable as the originals for breeding, he said.

George Seidel, a cloning expert at Colorado State University, says three factors make us who we are. The first two are genetics and the environment. The third is what's called epigenetics, which combines aspects of the other two.

The term epigenetics refers to proteins and other chemicals that attach to DNA and act as markers, determining how the code is read -- hiding

some stretches and exposing others -- like the marks of a censor's pen. Those marks tell cells whether to act like skin or heart or fertilized egg.

That's why even identical twins are slightly different -- there's some randomness in the way the epigenetic markers stick to the DNA throughout the body. In a horse, that might make the difference between a great racer and a good one.

Epigenetics may also explain the defects seen in clones. Normally, sperm and eggs get their epigenetic codes "reset," allowing them to start anew when they come together. Cloning mimics that process, albeit imperfectly.

But Seidel and others say there's no evidence that cloned animals die younger than ordinary ones. That misconception was spread when scientists discovered that Dolly had unusually short telomeres -- microscopic structures that cap the chromosomes.

Short telomeres are associated with premature aging, and Dolly did have arthritis, but scientists never established whether she was aging prematurely. She died of a viral infection at age 6.

Hinrichs said short telomeres have been reported in animals cloned from mammary tissue, as Dolly was, but not in those cloned from skin cells, as Gemini was. Gemini will live in Texas until New Jersey warms up in the spring.

"I just feel very lucky that we had Gem Twist and were able to enjoy him, and now we're very lucky we can continue that line," Chapot said. As for testing him on the jumps, she said, "we probably won't be able to resist it."

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