The Hybrid Zoo

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Grade Level: 9-12
Subject Area: Biology

Project Summary: Students with use their knowledge of genetics, ecology, and evolution to create a hybrid animal or plant. They will have to read an article about real life hybrids and then create their own. Besides drawing and coloring the hybrid, the student will also have to pick a habitat that is appropriate and also find that habitat on the globe. In addition, the student will have to list three adaptations that hybrid animal has that allow it to survive in its environment. It becomes a "zoo" when the teacher and students scan the pictures into the computer; the pictures are put online to be shared so all students can see the creations of their peers.

Introduction:

Project Description: In this project, students are asked to create a hybrid animal or plant. Students learn what hybrid animals are and also learn about adaptations. Then the students have to name the project, draw and color their hybrid animal, write about its habitat and why it would survive there. Finally, they will learn to scan their work into the computer so that the rest of the class and other periods for years to come will be able to view their work.

This project works because many students love animals and many can express their knowledge through art. Many students also love nature and have an interest in animals. As kids, many of them have been to the Santa Barbara Zoo and therefore have prior knowledge, experiences, and memories that they can draw from.

Educational Value: According to the new Bloom's Taxonomy (revised in 2001), creativity is at the top of the pyramid. This is significant because that is the goal of the project: create a new creature that does not really exist and also place it into a current habitat and explain why it will survive there based on its adaptations. The educational value is in getting the students to combine their knowledge from the units of evolution and ecology and use their own thinking to devise their hybrid.

Lesson Plans:

These lessons are written for the typical 45 high school science class. Teachers on a different schedule will have to adapt them for their schedule.

Lesson #1

Objectives: Introduce the concept of hybrids and adaptations.

- Daily questions done in the student's notebook (5 minutes)
    - What is an adaptation?
    - What is a hybrid?

- Go over the answers eliciting student participation (5 minutes).
- Begin PowerPoint about adaptations having students take notes (20 minutes).
- After students complete taking notes, transition to having students read hybrid article (15 minutes)
- HW: have students pick their favorite two hybrids from the article and comment on why they were the favorites.

Lesson #2

Objectives: Student will begin the creative process of making the hybrid.

- Begin class by checking the HW and having student volunteers share their favorite hybrid from the article (5 minutes).
- Introduce project, explain the requirements, and pass out the instruction sheet with all of the requirements on it (10 minutes).
- Allow students to begin drawing their hybrid (30 minutes).
- Circulate throughout the classroom and assist students that need help.
- HW: Finish drawing and coloring hybrids.

Lesson #3

Objectives: Student will list the biome and adaptations of their hybrid. Students will scan their hybrid into the computer.

- Demonstrate how to scan a document into classroom computer. Be sure to go over where the students are saving it and also what to title their file (5 minutes).
- Review expectations for hybrid biomes and adaptations (2 minutes).

- Allow students to complete their hybrids and scan them into the computer (30 minutes).
- When done, allow students to walk around the classroom and visit the "zoo" exhibits of their classmates. If the technology is available, the teacher may opt to place the documents on an LCD projector, ELMO, or other similar technology to allow students to see the work of their peers (8 minutes).

Instruction Sheet:

The Hybrid Zoo

Purpose: To create a hybrid animal that lives in a habitat and that has at least 3 adaptations.

Project requirements: You will draw and animal or plant that combines traits of the two creatures.

- The organism cannot be currently living on Earth.
- You must name the hybrid (for example the whale + the bat = the what).
- The drawing must be on blank white printer paper.
- The hybrid must be colored in.
- On the back, you must list what biome the organism lives in and where it lives geographically (for example: the what lives in the ocean near the Channel Islands)
- On the back, you must list 3 adaptations that help *each* of the parent animals survive (for example: whales are large, can swim, and have blubber to keep them warm and bats can fly, use echolocation, and have a great sense of hearing).
- On the back, you must list 3 adaptations that help your hybrid survive (for example: the what has wings that help it fly away from predators, its large size helps to discourage predators from attacking it, and its tail helps it swim. The 3 adaptations should be chosen from the list above.
- When you are done, you must scan your drawing into the computer so that it can remain in the "zoo"!

Rubric:

Student Name: _____

CATEGORY	4	3	2	1	0
Content	My hybrid is creative and accurate.	My hybrid is a combination, but not very creative.	My hybrid is indistinguishable from normal, currently existing organisms.	My hybrid lives around the corner.	No evidence.
Drawing and coloring	I am ready to work for Disney.	I did a nice job even though I am not very artistic.	I could have used more colors or colored in between the lines.	Please help me pass Art.	No evidence.
Biome	I put my hybrid in the right environment, including an example of a geographic location where it can be found on the earth.	I put my hybrid in the right environment but did not give an example location.	My hybrid might survive in this environment, but I could have found a better fit for it.	Let's have a moment of silence; this hybrid will die in this environment.	No evidence.
Adaptations	I listed 3 appropriate adaptations that are shown in the diagram.	I put 2 adaptations that were correct.	I have 1 correct adaptation.	My adaptations are wrong and my hybrid creature will die.	No evidence.
Effort	I tried my best.	I did a good job.	This was fair.	I don't want anyone to see my project.	No evidence.

Student Impact:

Students will learn:

- what a hybrid animal is
- what adaptations are
- what habitats are
- how to scan a document

Assessment:

A rubric is used to make sure that the student projects are graded consistently. Students should be given the rubric prior to starting the project.

Standards:

Biology

8 b. Students know a great diversity of species increases the chance that at least some organisms survive major changes in the environment.

Investigation & Experimentation

1l. Analyze situations and solve problems that require combining and applying concepts from more than one area of science.

Materials/Budget:

This is a pretty low budget activity. After completing the units on evolution and ecology, teachers will need

- Blank white paper
- Colored pencils
- The article about hybrid species that I can supply
- A scanner
- A computer
- Support from the District IT staff to put the completed file online or knowledge of

how to host files online. This part, while cool, is optional. The teacher can display them around the room for others to see and/or scan them into a document and display them using a Lumens/LCD projector (if available). By scanning them in to the computer or putting them online, this allows the teacher to display the "zoo" time and time again. It also provides the student motivation to know that their project will be displayed in the zoo for other students to see.

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What makes a species?

SCIENTISTS STUDY REAL-LIFE HYBRIDS—LIGERS, ZORSES, AND WHOLPHINS—FOR THE ANSWER

PLUS

- PLANET EARTH: THE ULTIMATE WORKAHOLIC?
- NAME THAT MYSTERY ELEMENT!

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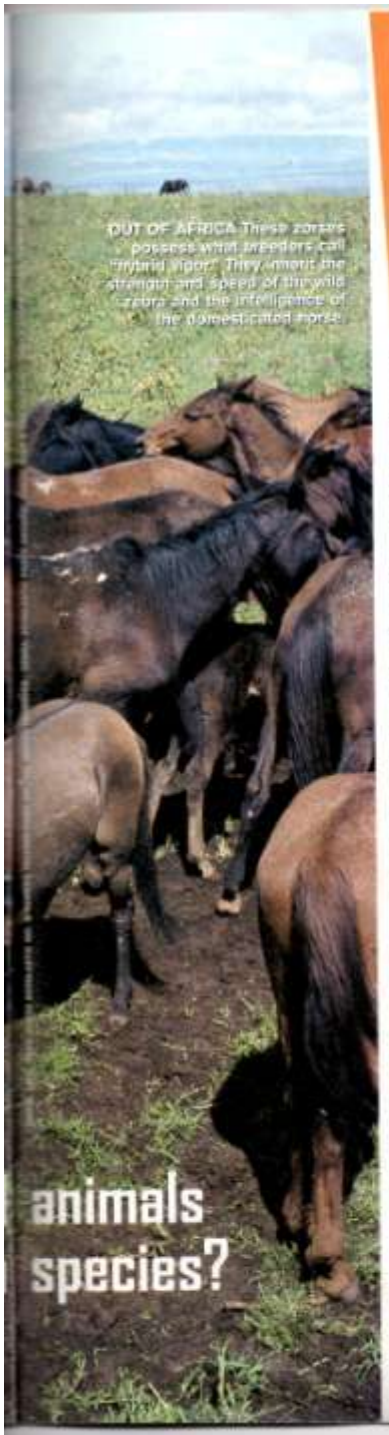
This "[illegible]" an imaginary cross between a zebra and an elephant, was created by a visitor at [illegible].com.

LIFE SCIENCE/BIOLOGY CLASSIFICATION • ANIMAL MATING

The Mating Game

Ligers, zorses, wholphins, and other hybrid raise a beastly science question: What is a

By Sharon Guynup



OUT OF AFRICA These zorses possess what breeders call "hybrid vigor." They inherit the strength and speed of the wild zebra and the intelligence of the domesticated horse.

animals species?

What has a mane like a lion, the sleek muscular body of a tiger, stripes and spots, and weighs up to 1,000 pounds? Answer: A liger. The punch line sounds like a joke, but ligers—produced by a female tiger mating with a male lion—are actual animals and one of the world's more bizarre-looking *hybrids*, or mixed animal species.

If these ferocious cats met in the jungle, a tiger would probably not choose to visit a pride of lions; a raucous brawl—not romance—would be the more likely result. But with little choice in captivity—like an open zoo—the odd coupling may occur. In the wild, animals rarely interbreed for one potent reason: The offspring are usually *infertile*, or unable to reproduce—which can spell extinction for a species. "Infertile offspring don't pass on their *genes* [hereditary instructions in all cells] to the next generation," says University of Maine biologist Judith Rhymerat.

But even more threatening to species preservation are hybrids that can reproduce. For example, over the past decade Midwestern barred owls have pushed westward to the Pacific coast where they've settled in the forest habitat of endangered spotted owls—and bred with them to create sparred owls. "It's a nasty situation," says Susan Haig, a wildlife ecologist at Oregon State University.

Hybrids can result in loss of genetic diversity, she explains, and there's no protection for them under the 1973 Endangered Species Act. By traditional species' definition—in which organisms with common traits breed to create fertile offspring—they shouldn't be mating: Sparred owls could trigger the Northern spotted owl's extinction.

BREEDING BARRIERS

While ligers are rare, some animals in captivity are deliberately interbred for greater strength or endurance, like mules (horse + donkey) and zorses (horse + zebra). They're also interbred for food, like the beefalo (cow + buffalo) and different types of catfish

ODD COUPLE Lions and tigers mate in captivity, but rarely interbreed in the wild.

and trout. Russians crossbreed dogs with jackals to create a hybrid whose superior sense of smell, for example, is put to the test sniffing out bombs in Moscow's airports.

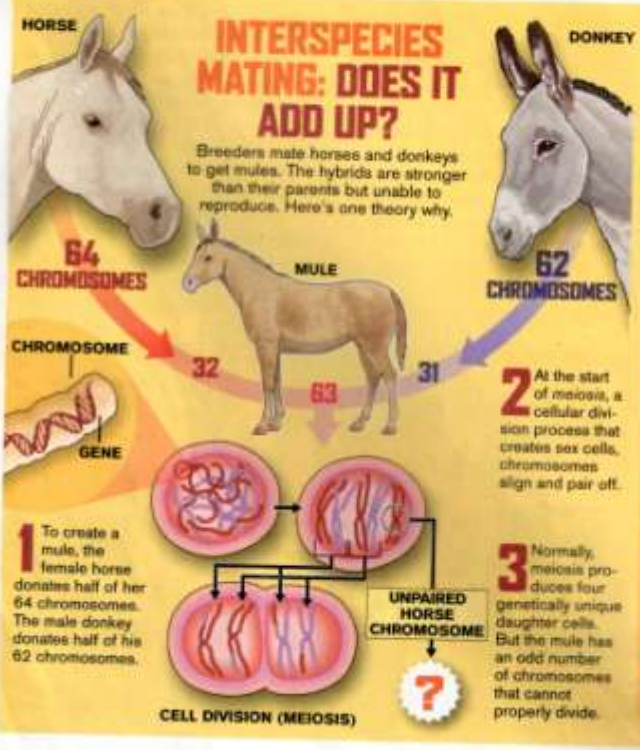
But why don't distinct wild animal species—like lizards and frogs, or cougars and elephants—mate of their own accord? The answer: Nature imposes *breeding barriers*, safeguards to protect individual species and help them adapt to their environment. Animals *evolve*, or develop unique traits over time, to ensure their survival. So specific genes that help a species adapt to a particular climate, eat what's on the local menu, and fight off neighborhood predators, are passed on to the next generation. Mixing genes through interbreeding can eliminate survival traits—or result in infertile offspring.

To produce fertile offspring, scientists think *chromosomes* (cell structures that house all the genes) from both a mother and father may need to pair off evenly during *meiosis*, a process of cell division that produces sex cells. For the hardy mule, for example, this is impossible, since its father—a donkey—has 62 chromosomes and its mother—a horse—has 64. When the two animals mate, each contributes half its chromosomes to the mule. In turn, the mule is almost always sterile because it inherits a total of 63 chromosomes, a number that can't divide into pairs (*see diagram, below*).

Sometimes the main breeding obstacle is a simple difference in habitat or breeding area—one species may fare

INTERSPECIES MATING: DOES IT ADD UP?

Breeders mate horses and donkeys to get mules. The hybrids are stronger than their parents but unable to reproduce. Here's one theory why.



REASONS WHY DIFFERENT SPECIES RARELY MATE

GENETIC Different species have different genes; chromosomes must align during meiosis.

BEHAVIORAL Species may not understand each other's mating and "courting" language.

PHYSICAL Reproductive organs may not be compatible.

CHEMICAL Unique *hormones* (chemical messengers) that help sperm (male sex cells) penetrate an egg (female sex cell) vary between species.

IMMUNOLOGICAL The *immune system* may recognize sperm from another species as foreign and kill it.

better in thick jungles, another in wide-open spaces. And even if separate species do mate—and a female's egg successfully *fertilizes*, or fuses, with a male's sperm—the parental genes must partner perfectly to develop a healthy *embryo* (living organism in its earliest stages of development). "Genes need to turn on and off at the right time, in the right places—millions of times—in order to form limbs and other body parts," notes Eric Hallerman, a geneticist at Virginia Polytechnic Institute and State University. "If they don't, the embryo dies or becomes grossly malformed—and then dies." The off-and-on gene sequence isn't the same in all species, because different species possess different genes—which means they don't coordinate properly.

Besides infertility, blindness, faulty hearts, and brief life spans are routine disorders for many hybrids. Case in point: When a 400-pound Atlantic bottlenose dolphin and a 4,000-pound false killer whale mated off the coast of Hawaii, their *wholphin* offspring died at age 5, decades younger than the average 40- to 50-year life span of its parents.

RULE BREAKERS

Many of today's newly created creatures would confuse 18th-century Swedish naturalist Carolus Linnaeus, who developed the Linnaean *taxonomic*, or classification, system for the natural world. Within this system, taxonomists have identified and grouped about 2 million plant and animal species based on similarities and differences. But how exactly do you define a species? "That's one of the biggest questions in science," says Rhymer. "It's what everyone is arguing about."

Traditionally, a species is a group of organisms that share at least one unique characteristic, can interbreed to produce fertile offspring, and rarely reproduce with organisms of another species. But what to make of fertile hybrids like the sparred owl? "The old definition of a species doesn't really work today," Rhymer says. "We know of related species separated by millions of years that still have the ability to reproduce successfully."

BABY MIX-UP. Biologist Lulu Skidmore holds baby Kamilah, the world's second cama, a cross between a camel (right) and a llama (left). Kamilah was conceived using artificial insemination and born on Feb. 27, 2002, at the Camel Reproduction Center in the United Arab Emirates.

FISH OR FREAK? This wholphin has 66 teeth—an even mix between parents. Bottlenose dolphins have 88 and false killer whales have 44. But how long will it live?

What is a species? "That's one of the biggest questions in science," says biologist Judith Rhymer. "It's what everyone is arguing about."

TOP DOG The coywolf inherits agile hunting skills from its coyote parent.

One such example: the canid family—wolves, coyotes and dogs—whose common forebear is the fox-size Eucyon that roamed prehistoric Earth around 4 million years ago. From the carnivorous Eucyon arose three distinct species of various body sizes and shapes—with different hunting and feeding habits. And unlike most related but distinct species, such as the horse and donkey, the canines share enough genetic similarities to produce healthy, fertile pups.

SMART MATING

Interbreeding doesn't always spell doom. When Florida's panther population plummeted to fewer than 30 during the 1980s, the animals began *inbreeding*, mating among direct relatives who share remarkably similar gene sets. Inbreeding, which greatly increases the odds of birth defects, spawned cubs with crooked tails, heart defects, and other medical problems. In other words, it made the panther population dangerously unfit for survival. To widen the *gene pool*—the total collection of genes in a species—the U.S. Fish and Wildlife Service (USFWS) brought in a closely related subspecies, the Texas cougar.

Today, panthers' numbers have shot up to at least 78, and females are birthing healthy, fertile hybrid cubs. Still, Rhymer calls the hybridization effort a last desperate attempt to save some fraction of the panther gene pool. "The USFWS could either have hybridized the Florida panther or let it go extinct."

Hybridization can be a natural evolutionary process, explains Nina Fascione of the Defenders of Wildlife organization. "But problems arise when it's human-caused," she says. Leveling forests forces organisms to search out new homes and breaks down natural barriers, allowing animals to encroach on each other's habitats, as in the case of the spotted owl.

For now, the USFWS is still wrestling over a federal policy on the status of hybrid species—especially those that threaten endangered species. "As habitats become more fragmented, we're going to find more and more examples of hybrids, and it's going to be a prime problem for conservationists," warns ecologist Sue Haig. ■

MINDS-ON SCIENCE

ALL IN THE FAMILY?

With more than 2 million known plant and animal species—and an estimated 10 million still nameless—it's no surprise scientists can disagree on how an organism should be classified. One example is the red wolf (*Canis rufus*). By traditional definition, a species does not interbreed with other species, yet the red wolf can breed and produce healthy offspring with both the gray wolf (*Canis lupus*) and the coyote (*Canus latran*).

Some scientists say the red wolf is a unique species because the size and structure of its head is significantly different from that of the gray wolf and coyote. Other scientists conclude that the red wolf is a hybrid species, based on genetic data that show its DNA to be remarkably similar to the gray wolf and coyote.

DEBATE IT: Is the red wolf a separate—or hybrid—species? Support your answer with scientific evidence.