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Date: _____ Period: _____

Speciation: Of Ligers and Men

Crash Course Biology #15

1. What is the Genus-species name of humans?
2. List organisms that are primates.
3. What is the definition of *species*?
4. Why are lions and tigers different species?
5. Animals like ligers are called _____, offspring that result from the cross-breeding of two distinct species.
6. _____ is the change in heritable characteristics of a species across generations.
7. Reproductive _____ means that two populations of the same species can no longer mate together successfully.
8. What is different between donkeys and horses?
9. _____ isolation means the parents can form a zygote, but reproduction is unsuccessful after that.
10. Pre-zygotic isolation happens before an egg is _____.
11. Pre-zygotic isolation can be _____ or _____.
12. When one species diverges into two different species because of geographic isolation, it's called _____.
13. Who is the person credited with the idea of natural selection?
14. When two species are reproductively isolate in some other way (non-geographic), this is called _____.
15. What event drastically reduced the bird populations on Daphne Major?
16. For different dog breeds, are pre-zygotic or post-zygotic obstacles more of an issue?

ANSWERS

Speciation: Of Ligers and Men

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1. What is the Genus-species name of humans?
Homo sapiens
2. List organisms that are primates.
Humans, monkeys, apes, lemurs, and tarsiers
3. What is the definition of species?
A species is a group of organisms that can interbreed and produce fertile offspring
4. Why are lions and tigers different species?
A liger is produced when a male lion and a female tiger breed. However, a liger is sterile, and therefore lions and tigers are still considered separate species.
5. Animals like ligers are called *hybrids*, offspring that result from the cross-breeding of two distinct species.
6. *Evolution* is the change in heritable characteristics of a species across generations.
7. Reproductive *isolation* means that two populations of the same species can no longer mate together successfully.
8. What is different between donkeys and horses?
Chromosome number
9. *Post-zygotic* isolation means the parents can form a zygote, but reproduction is unsuccessful after that.
10. Pre-zygotic isolation happens before an egg is *fertilized*.
11. Pre-zygotic isolation can be *behavioral* or *geographic*.
12. When one species diverges into two different species because of geographic isolation, it's called *allopatric speciation*.
13. Who is the person credited with the idea of natural selection?
Charles Darwin
14. When two species are reproductively isolate in some other way (non-geographic), this is called *sympatric speciation*.
15. What even drastically reduced the bird populations on Daphne Major? *Drought*
16. For different dog breeds, are pre-zygotic or post-zygotic obstacles more of an issue?
Various dog breeds are similar enough that post-zygotic isolation isn't an issue. Rather, pre-zygotic obstacles are more common because of the physical challenges of mating dogs of greatly different sizes.

CrashCourse Biology #15 – Speciation

Video Info: This video can be accessed via YouTube:

<https://youtube.com/watch?v=2oKIKmrbLoU>

Video length: 10:25. Using the table of contents provided by CrashCourse with the YouTube video, you can click and watch certain sections as desired.

Transcript (retrieved from <https://nerdfighteria.info/v/2oKIKmrbLoU> and re-formatted):

Introduction

You and me? We got some stuff in common. More in common than, say, you and my dogs Lemon and Abby here. For starters, you and I are probably, like, the same species. And Lemon and Abby are dogs, which is a different species.

As you may have guessed by now, this video is going to be about species. But, at the very end, we're going to talk about dogs. So hang in there, 'cos the puppies are comin'.

But before we bust out the puppies, let's talk about people.

1) Species (0:30)

Our species, *Homo sapiens*, is the single remaining member of the genus *Homo*. Our buddies *Homo erectus* and *Homo habilis* and *Homo neanderthalensis* bought the farm a long time ago. So these days, all us *Homo sapiens* are pretty different from even our closest living relatives in the Animal Kingdom, the chimps and bonobos.

Humans are a species, a specific type of organism that's different from all the other types of organisms out there. But what is it that makes us human? Well, we're a specific type of animal called a primate. Monkeys, apes, lemurs, and tarsiers are also primates. Unless you're Sasha Baron Cohen or something, most of us are lacking significant body hair. We're bipedal, meaning we stand on two feet, and we've got these huge-normous brains that allow us to do all kinds of stuff like talk real good, solve complicated problems, and write bad poetry during adolescence. And, you know, also, like figure out how little we can get away with tipping a mediocre waiter at a restaurant without seeming like a total prick. That, my friends, is something that giraffes rarely have to deal with.

But being a species is more than just having a bunch of stuff in common. Instead, we describe a species as a group of organisms that can interbreed and produce fertile offspring. Seems pretty simple, right? Two of the same species that can produce blah, blah, blah, blah... HEY! Pay attention! That last part is important! The two organisms need to be able to produce fertile offspring. It seems like it would be enough for organisms of the same species to be able to make babies, but those babies need to be able to make babies, too.

2) Hybrids (1:52)

Now it turns out, two animals of a different species can sometimes technically have a baby. Take, for instance, the noble liger, Napoleon Dynamite's favorite animal, which I would know because I had the very best Napoleon Dynamite costume in the United States for Halloween in 2005. But I didn't just bring up ligers to brag. A liger is what happens when a male lion and a female tiger have a little cub. Only it's not very little because a liger is generally larger than both of its parents AND ligers are sterile.

Which leads us to our understanding of what makes a species: lions and tigers are different species because they don't produce fertile offspring together. We call animals like ligers hybrids, offspring resulting from the cross-breeding of two distinct species. And even though hybridization between two animals is a dead end when it comes to creating a new species, we know that through evolution, or the change in heritable characteristics of a species across generations, new species have formed in the past,

and they continue to develop all the time.

3) Reproductive Isolation (2:48)

It's tough to nail down every single way that this process we call speciation can happen, but we know of at least a couple of ways that species evolve into other species and they both involve one requirement: reproductive isolation. Meaning that two populations of the same species can no longer mate together successfully. Note that I said successfully. One way populations can become isolated from each other is that they can mate, but their offspring aren't fertile or viable.

Ligers are a good example of this. So are mules, they're the product of a male donkey and a female horse. Unlike lions and tigers, donkeys and horses don't even have the same number of chromosomes. So even though the donkey sperm can fertilize the horse egg, the mule won't have the genetic instructions it needs to produce its own sex cells.

a) Post-Zygotic (3:31)

This kind of isolation is called post-zygotic isolation, because the parents can form a zygote together, but after that it's all over for their lineage. Other examples of post-zygotic isolation include pairings of species that always lead to miscarriage or no development of the embryo at all, or things produce, like big fetuses that kill the mother at birth.

b) Pre-Zygotic (3:51)

The other type of isolation is pre-zygotic, meaning that the isolation happened between groups of the same species before an egg even thought about getting fertilized. This can include stuff like behavioral changes within a species, like when birds of the same species start singing two different songs to attract mates. Or when one group of a species that does all its business in the daytime gradually becomes nocturnal, so the two groups never end up hanging out at the same time.

Pre-zygotic isolation can also be geographic, meaning simply that the populations are separated by great distance or physical barriers, so that they can no longer get together and bump uglies.

4) Allopatric Speciation (4:23)

When one species diverges into two different species because of geographic isolation, it's called allopatric speciation. Allopatric coming from the Greek for "different countries". The two populations of a species end up evolving differently because the conditions are different on each side of this river here. For instance it might be colder on one side of the river, so the animals on this side grow thicker, and more luxurious coats because those guys just do better over there. They probably also put on thicker layers of fat, and change their behavior, and accumulate a bunch of other possibly random changes. Meanwhile, on the warm side of the river, these animals also accumulate changes, and lose some fur, add a bunch of sweat glands. Given enough time, and given a complete lack of gene flow between the two populations, thick-coated animals will eventually only be able to breed with other thick-coated animals, and sweat animals with sweaty animals.

This propagation of specific traits based on how kick-ass those traits make the animal that has them is called Natural Selection and a guy named Charles Darwin, or Chuck Darwin, or Chucky D to his friends, was the one who let us know what was up with natural selection and how it can lead to allopatric speciation. Now stop me if you've heard this one before, but Darwin visited the Galapagos Islands in the 1830s.

So Darwin was obsessed with barnacles, but that did not keep him from noticing the finches, which were actually misidentified by him as grosbeaks, on each island which were all pretty similar to the finches on other islands AND very similar to the ones on the

mainland of South America. BUT, they were also obviously their own species. Darwin believed that the process that led to these finches becoming separate species was [video is slowed down] incredibly slow, [returns to normal speed] so slow that we couldn't actually witness the process, we just had to take his word for it.

5) Sympatric Speciation (6:03)

Now for a long time after Darwin made these observations, allopatric speciation was the main explanation for how species diverge. But today, we know that's not the whole truth. Now, we've got lots of new-fangled DNA testing and other special gadgetry that tells us that one species can diverge into two without being geographically separated, but instead, when they're reproductively isolated in some other way. This is called sympatric speciation, meaning 'same country' speciation, and it also means that it's time for a trip to the chair!

6) Biogeography (6:32)

So, here's a little biological love story for all you romantics out there. Peter and Rosemary Grant, two British evolutionary biologists - they are in fact, a married couple - have, since the early 1970s, been spending six months of each year together on a secluded island in the Galapagos studying Darwin's finches, trying to catch them in the act of evolving. These are, mind you, the same animals that Darwin studied and they ones that he said were evolving at an imperceptibly slow pace.

The island in the Galapagos that the Grants hang out on is called Daphne Major, and when they started their research in 1973, it was occupied by two different finch species: the medium ground finch and the cactus finch. But in 1981, another finch arrived on Daphne Major from a nearby island. It was a ground finch-cactus finch hybrid, and it was a whole lot bigger than either of the local finches. Its beak was also extra wide, and its song was like a mash-up of the jams ground finches sang on its home island and the ones sung on Daphne Major. So the newcomer set to work crooning to the local ground finch ladies, and eventually landed one. The Grants followed the descendants of these two birds for the next 28 years.

But after about four generations, Daphne Major experienced a severe drought which killed many of the finches. There were only TWO surviving descendants of that one immigrant finch, sort of like cousins of each other, basically, and they mated with each other, and that seems to have set the stage for speciation to occur. The descendants of these two survivors sang a very distinctive song that was learned from their parents which was different from the other Daphne Major finches. Gradually, as the finch population on the island rebounded, the hybrid finches, the great-great-great-great grandchicks of that one bird, began mating exclusively with each other.

In December of 2009, the Grants announced that, since the drought, the lineage of that one immigrant ground finch has been genetically isolated from the other local finches on the island. So, that, my friends, is both super romantic and also an excellent example of super-quick sympatric speciation in action.

7) Dogs (8:37)

Okay, so I promised you puppies, I'm gonna give you puppies. You've probably noticed that, you know, a corgi looks pretty different from a greyhound. They were bred to be different. Corgis were bred to herd animals and guard farm houses, while greyhounds were bred, you know, mostly to run.

Dog breeding kind of takes the "natural" out of selection, in fact, it's what we call artificial selection. But it's still a kind of selection. So you've probably wondered what it would be like if a corgi and a greyhound had puppies together. Because they CAN have puppies together. Even though that's really weird. What's that, Lemon? You're both girls? Oh, well- anyway...

My point here is that they're the same species, meaning that these dogs, even like different-er dogs, like an Irish wolfhound and a chihuahua, could have fertile offspring together. Like, how? How? HOW? Would-How?! Various dog breeds are similar enough that post-zygotic isolation isn't an issue. But in a natural setting, a chihuahua-wolfhound pairing would be extremely rare because of the, y'know the difficulties involved in the gettin'-it-on process. Or pre-zygotic obstacles.

So think about it like this, if you were to put a bunch of chihuahuas and a bunch of wolfhounds on an island somewhere, they probably wouldn't breed together and if they did, the birthing process, at least for the chihuahua mommies would be... Gah! Oh god. But what this means is that the gene flow between the two groups would stop and they would become reproductively isolated. Over time, they would become different enough that they could no longer successfully breed together at all, and thus become different species.

Conclusion (9:58)

Thank you for watching this episode of Crash Course. If you missed anything don't forget to go back and review. If you have any questions, please ask them in the comments or on Facebook or Twitter. We will endeavor to answer them. Thank you to everyone who helped put this episode together. We'll see you next time.