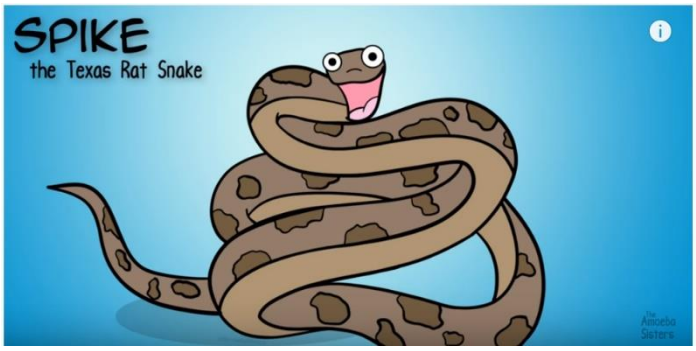
Amoeba Sisters DNA, Chromosomes, Genes, and Traits: An Intro to Heredity Video

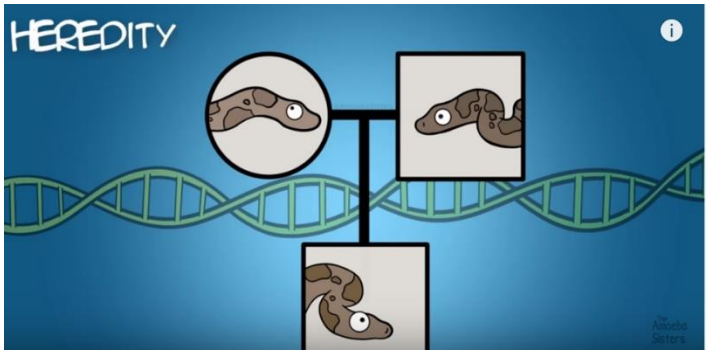
The week before the 1st day of my first year of teaching…wow, over a decade ago…was an exciting time. It was also stressful because I'm a bit of a perfectionist---but a bit of a messy, unable to decorate my classroom kind of perfectionist---actually maybe I'm not a perfectionist. I wanted to make my classroom inviting and exciting and…I really wanted my students to walk in and think, "This is AMAZING." I could never make it look like what I imagined up.

But, the most amazing thing did happen in the week to follow. I knew a colleague who had a friend who had a son who was going to college-confusing- but anyway that son could not take his pet snake to college with him. Some rule about dorms and snakes. My colleague asked, "Would you like it? They said they'd give you the cage and everything; it could be a classroom pet." I didn't even have to think about it. Of course. So Spike, a Texas rat snake, became a classroom pet, an amazing, popular one at that. He was friendly---well, for a snake… he'd let you hold him and not bite.



That year, I was the only one in the science wing with a pet snake and I'm pretty sure there were some people that wondered what was the point. Well, I'm big on a relevance so anytime I would teach a biology concept, I found some way to work in Spike. Predation? Well, let's talk about Spike's appetite for rats. Mitosis? Let's talk about why Spike even needs to make more cells.

One day in tutorials, a student asked me, "Since Spike's parents were bred in captivity, did you ever see Spike's parents? Do you think Spike's parents looked like him?" You can't ask a question like that and not expect an answer. It was a GREAT question because we were getting close to our heredity unit.

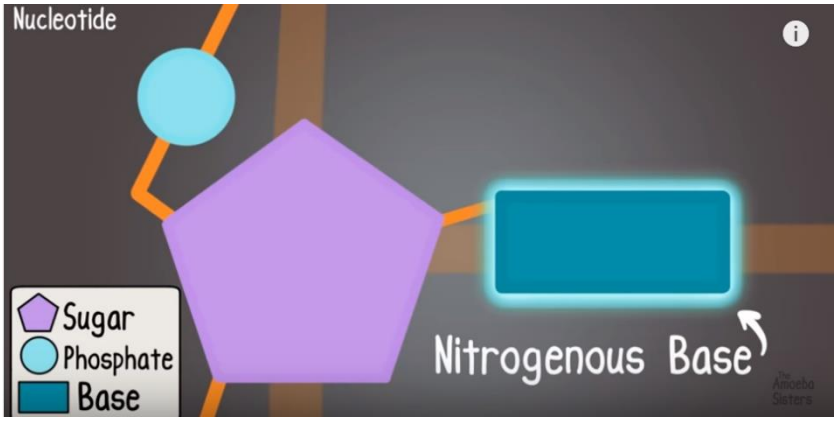


Heredity is about how traits are passed down from parent to offspring. We've made a playlist of our videos that focus on heredity including reproduction, how to track inheritance in pedigrees, how to solve genetic problems in Punnett squares, and understanding different Mendelian and non-Mendelian inheritance. But you really can't delve into those and study heredity without understanding DNA, chromosomes, genes, and traits- and that's what this introductory video is going to focus on.

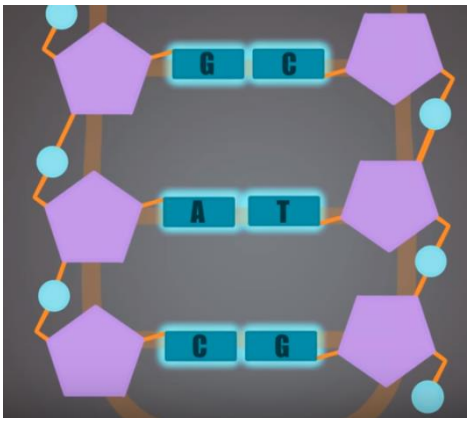
So back to the student question. Spike has traits. The patterns on his body, his size---these are all traits. These traits are coded for in his DNA. Some of the traits he inherited can be influenced by the environment. For example, if Spike had not had the nourishment he needed, that could affect his size. Spike's DNA---the whole DNA code---is actually found in nearly all of his body cells. DNA is not just one big code buried deep down in an organism like some treasure. Spike's DNA is in the nuclei of nearly all of his body cells. He inherited his DNA from his mother and father. I can't know for sure what Spike's parents looked like, but I do know that Spike inherited his DNA from them.

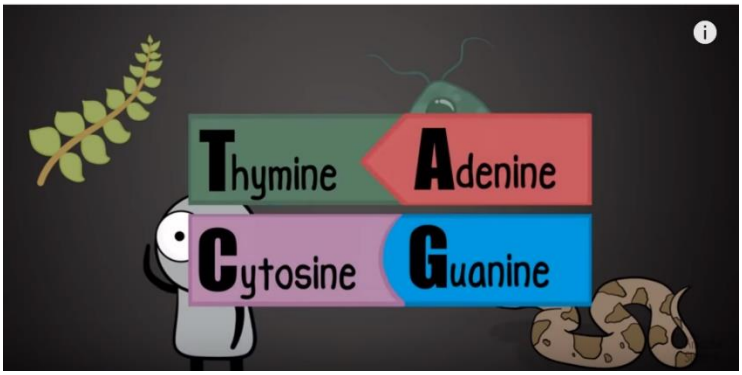
One fun fact: many snake species can reproduce asexually. Had that been the case for Spike, he would have inherited all of his DNA from only one parent. But it would still be DNA coding for traits. Just like Spike, your DNA codes for your traits, and your cells can't function without it. DNA determines how tall you are, what color your eyes are, what color your hair is, or even if you're at risk for certain diseases. Also like Spike, your ENTIRE DNA code is in most of your body cells. That's why in those crime solving shows, which we may or may not absolutely love, a criminal can sometimes be caught by just leaving a cell from a hair follicle behind.

DNA has a beautiful structure and that structure will help you understand how inheritance works. DNA stands for deoxyribonucleic acid. It's a type of nucleic acid. If you remember from our biomolecules video, nucleic acids are a type of biomolecule. Nucleic acids are made up of building blocks called nucleotides. Nucleotides have 3 parts. One of them is a sugar called deoxyribose. One of them is a phosphate. We sometimes say DNA has a sugar-phosphate backbone. But the most important part of the nucleotide is the base, because the sequence of the bases actually code for traits. So as far as the bases go, there are four types of bases in DNA.

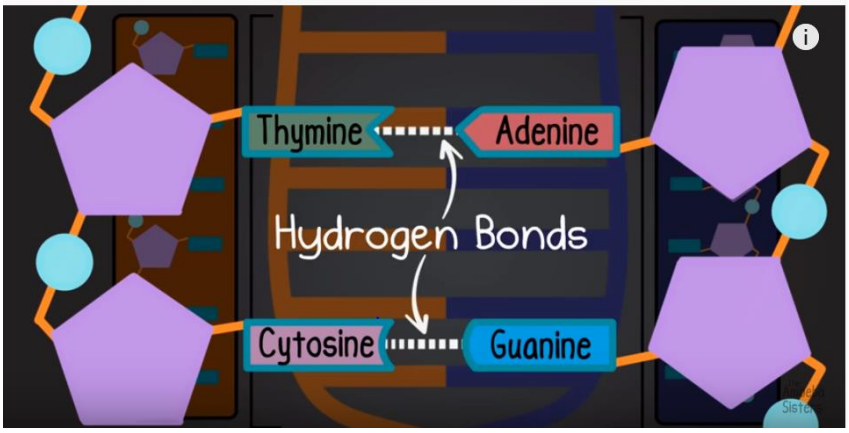


A lot of times they'll just use the letters A, T, C, G. The a is for adenine. The T is thymine. The C is for cytosine, and the G is for guanine. These bases actually pair in a specific way, and there is a popular mnemonic that can help you remember which of them pair together: apples in the tree; that tells you that A for apples, T for trees, because the bases A and T go together. The other verse is: car in the garage; that can help you remember that the base C always goes with the base G.

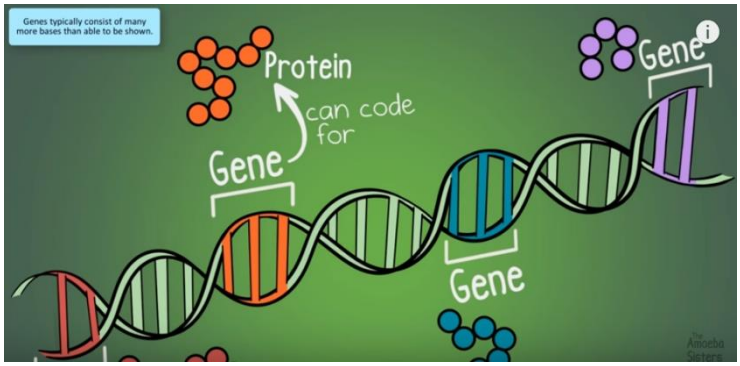




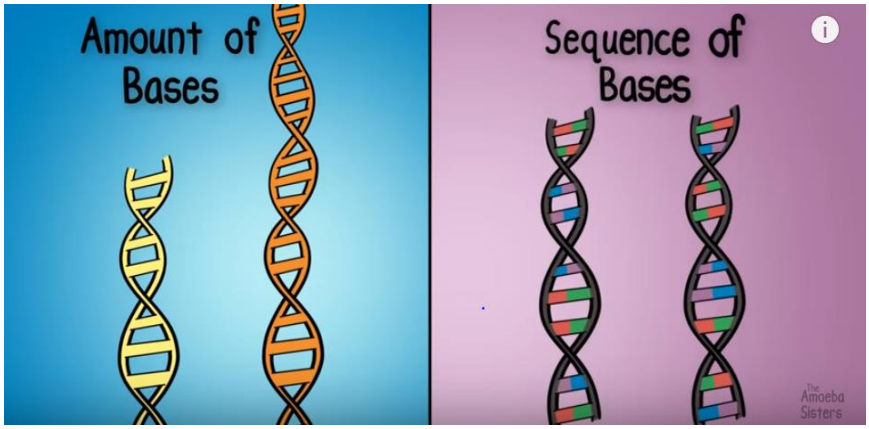
Regardless of whether we're talking about Spike, or a plant, or a protist, or a human like you…these are the DNA bases in living organisms. But the amount of DNA bases overall---and the sequence of those bases we mentioned----will vary among different species, and also, among different individuals.



But…it's likely to infer that Spike has a sequence of DNA bases that is more similar to his parents than he would to, say, a rattlesnake. DNA has two strands so there are nucleotides running up one side and there's nucleotides running up the other side. The bases are what pair in the middle. The bases are held together by hydrogen bonds.

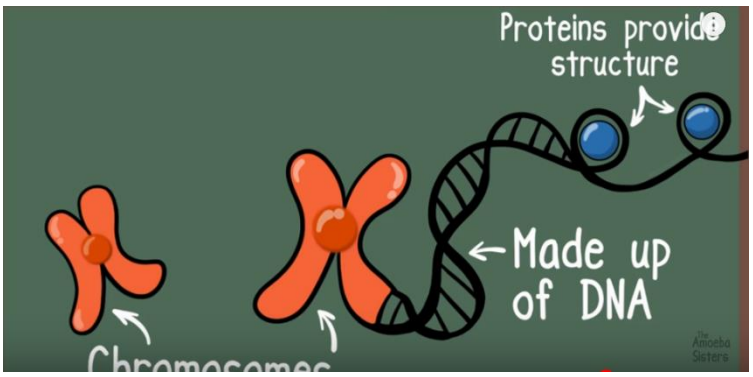


The DNA is also twisted in something we call a double-helix shape. Portions of DNA make up genes. We can say, for example, that this part of the DNA here makes up a gene. Genes can code for proteins. Proteins can have a huge role in expressing a trait. For example, let's consider your own eye color. Human eye color is a pretty complex trait that is actually determined by many genes. The genes can code for proteins involved in producing the eye color pigment. But proteins coded for by genes play a wide variety of roles besides just your eye color. Proteins are involved in transport, in structure, in acting as enzymes that can make all kinds of materials, in protecting the body…and so much more.



We do want to mention that not all genes are used to make protein. And there are parts of DNA that are noncoding. And even though nearly all of your body cells have your entire DNA code---your body cells may only use certain portions of those genes. Genes can be turned on or turned off by a variety of mechanisms. We call that gene regulation; check out our video on that.

Now you have a lot of DNA. When it is compacted, it can be organized into a unit called a chromosome. Very helpful when you're trying to make more cells and need to get the DNA into those new cells. Chromosomes in your body involve DNA wrapped around protein structures.



Humans have 46 chromosomes. That means nearly every body cell in your body has 46 chromosomes. Human sperm and egg cells, on the other hand, each contain 23 chromosomes. So you received 23 chromosomes from your mother and 23 chromosomes from your father to give you your 46 chromosomes. Your genetic code.

So let's do a recap of the big picture: here's a single chromosome. You see genes on this chromosome. These genes consist of portions of DNA. DNA is made up of nucleotides, and it's these bases here---the sequence of them---that makes the difference in coding traits.

Phew. Understanding this foundation is essential for understanding heredity---whether you're talking about you----or Spike.