Genomics in Society
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Clip #3 Transcript: Genomics Concepts and Terms & Some Advice

We should really value and care about the biodiversity that we have on our planet, we should really appreciate it, and one of the many ways of doing it [valuing and caring about biodiversity] is studying it and understanding it.

Genomics is essentially being able to **sequence** almost every single **base pair** of DNA in an organism, so let's say in a tree because that's the basic unit that is then translated into what becomes a tree. The genomics techniques we use are really **high-throughput**, like 30 years ago you wouldn't be able to do this. But now we have the power to sequence the whole cohort of DNA in a tree. Essentially we extract the DNA from the tree, and then this little ball of DNA goes into a high-throughput sequencing machine which really rapidly is able to **amplify** all of these A/T/G/Cs in these trees—so all of the DNA base pairs in these trees. What we do is take these DNA sequences, because don't actually do the sequencing ourselves, it's these big expensive machines, so usually some universities can afford to have them for a whole department, but usually it's like companies that we outsource the actual sequencing to. So we take the DNA, and then we send the DNA to these companies, they sequence the DNA, and they send us the data which is just strings and strings like terabytes of A/T/G/C. And then as a computational biologist, what I do is I develop tools in **coding languages** in **R** or **Python** to try to understand the A/T/G/C's.

Because at the basic level you've got the DNA which gets transcribed into the RNA, which gets translated into **proteins** which go like build the leaf or go build the tree in the most simplest forms. So the genomics part of CoAdaptTree is basically being able to sequence all these DNA from these trees in a very high-throughput manner. So we can do as much of the DNA as possible through hundreds of trees through tens and hundreds of populations and we can very rapidly use our **computational pipelines**—so the code that we generate—to analyze this data and to understand adaptation to climate or disease or whatever.

So these R and Python: what you basically do is you give it an instruction and it follows your instruction and gives you an output. Think of it as a software, like for example if put a raw picture of your latest selfie and then it outputs a brighter picture, so like a filter. So you input goes in raw, comes out looking slightly better, or it comes out doing something that you wanted it to do.

So **SNP** is [a nucleotide/nucleotides] you can very quickly genotype. So we all have DNA, and let's say in a certain part of your DNA you have a base pair which is T and I have a base pair which is A, and we know DNA is only made up of 4 base pairs (A, T, G, and C). So let's say are a T and I am an A—now what the **SNP array** can do very quickly is extract the DNA let's say from you and me and be able to tell us you have a T, and I have an A and I'm very good at adapting to really hot climates while you are better adapted to cold climates. So what a SNP array can do is very quickly tell you the genotype—so let's say T for you and A for me or of a tree—it can very quickly tell you what the genotype is of that tree and it will help inform how you will conserve that population of that tree based on what we know. These A's and T's and we know which environment they are associated with based on these **upstream studies** that we have done.

The most basic thing would be to understand how DNA gets transcribed and translated in a cell and basically understand how new mutations occur in certain regions of the genome; understand **natural selection**, so what does that mean in terms of the survival of a population. Understanding **heredity** is very important because you need to understand if there is a particular **trait** that you are interested in, is it heritable or not. And if it is heritable, then what components of the DNA that change this heritable trait, how much are they contributing to this trait.

Not only will this [research] empower students, but also empower the society, the community, and the country that they belong to; and zooming out it will be great for the planet as a whole. Biodiversity is important and we should understand and appreciate it more.