Welcome to this lesson on genetic probability and Punnett squares. Today, we are going to be taking a look at how Punnett squares can be used to determine the probability that traits will be passed from parent to offspring.

Punnett squares are tools that are used to determine the probability or the chance that a trait will show up in an offspring. Traits are characteristics of an organism that are determined by their genes. Traits are inherited characteristics. An example of a trait could be eye color, height, hair color, certain genetic disorder. These are different things that are characteristics of an organism that are determined by the genes that they have inherited.

We're going to take a look at two examples of Punnett squares, so you can see how they're used. Basically, when you set up a Punnett square, you're just going to draw a square like this. What we're going to do in a Punnett square is we're going to cross the alleles of the mother by the alleles of the father. We're crossing the parents' alleles.

This first example we're going to do is we're going to be using sex chromosomes. Let's say two parents want to figure out what the odds are that they will have a child that is female. We're going to put the alleles of the mother on top.

And actually, it doesn't matter. You can do the alleles of the mother on the side and the father on the top. It really doesn't make any difference.

But for this example, we'll put the alleles of the mother here. So these are the mothers alleles. And we know that for sex chromosomes, for an individual to be a female, they have two X chromosomes. The mother then has two X chromosomes.

And then, we're going to put the alleles of the father here. So these are the fathers alleles. For a male, their sex chromosomes are one X and one Y.

So then, here comes the fun part. I actually love doing Punnett squares. We're going to cross these. We take the X here and cross it with the X here. And we end up with XX.

Then, we take this X and this X, cross them into this box, and we end up with XX. Then, we take the X and the Y and cross them in this box. And then, we take the X and Y again and cross them in this box. So basically, this is giving us an idea of what the outcome would be if these two parents with these alleles for this trait made it.

We can see that 50% of the offspring-- grab a different color here-- would be female. Female is indicated by the two X's. So 50% would be female. And then, we can see that 50% would be male, XY. So if they wanted to know

what the odds are that they would have a female child, we know it would be 50%, judging by this Punnett square here.

Let's do one more example. We're going to set up a Punnett square related to hairline-- whether a person is going to have a straight hairline or a widow's peak. Widow's peak is a dominant trait. So if a person has at least one dominant allele, they will have the widow's peak.

Let's say that the mom is homozygous dominant for widow's peak. Homozygous dominant means that-- the prefix, homo, means the same and dominate. So both alleles are the same and both are dominant.

We know that the mom is homozygous dominant for this trait. So she has a widow's peak. Her genotype is big W big W-- the alleles that represent the trait. And her phenotype, then, would be a widow's peak. Her hairline would be a widow's peak. That's her phenotype.

Let's say that the dad is heterozygous for the trait. Heterozygous-- the prefix, hetero, means different, so they have one big allele and one little allele for the trait. His phenotype also would be a widow's peak, because it's a dominant trait. So if you have at least one dominant allele, it masks that recessive allele. The dad will also have a widow's peak as his phenotype.

Let's go ahead cross these and see what we end up with. We're going to get big W big W in this box, big W big W in this box, big W little w in this box, and big W little w in this box. We can see that, because each box has at least one big W, 100% of their offspring will have a widow's peak.

All of them have at least one big W. It's a dominant trait, so all of the offspring will have a widow's peak-- 100% of the time. So that's how we use Punnett squares in order to determine the probability of a trait showing up in an offspring.

All right, so the law of independent assortment is a law that states that the vast majority of traits are inherited independently of one another. What this means is that the inheritance of one trait is not influenced by the inheritance of another trait.

Basically, it's saying that the inheritance of a Y chromosome does not influence, or is not dependent on, the inheritance of a widow's peak, for example. So traits are inherited independently of one another. And the inheritance of one trait does not depend on the inheritance of another.

This lesson has been an overview on genetic probability and Punnett squares.