Introduction to Cell Biology
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Introduction to Genetics - Part 2

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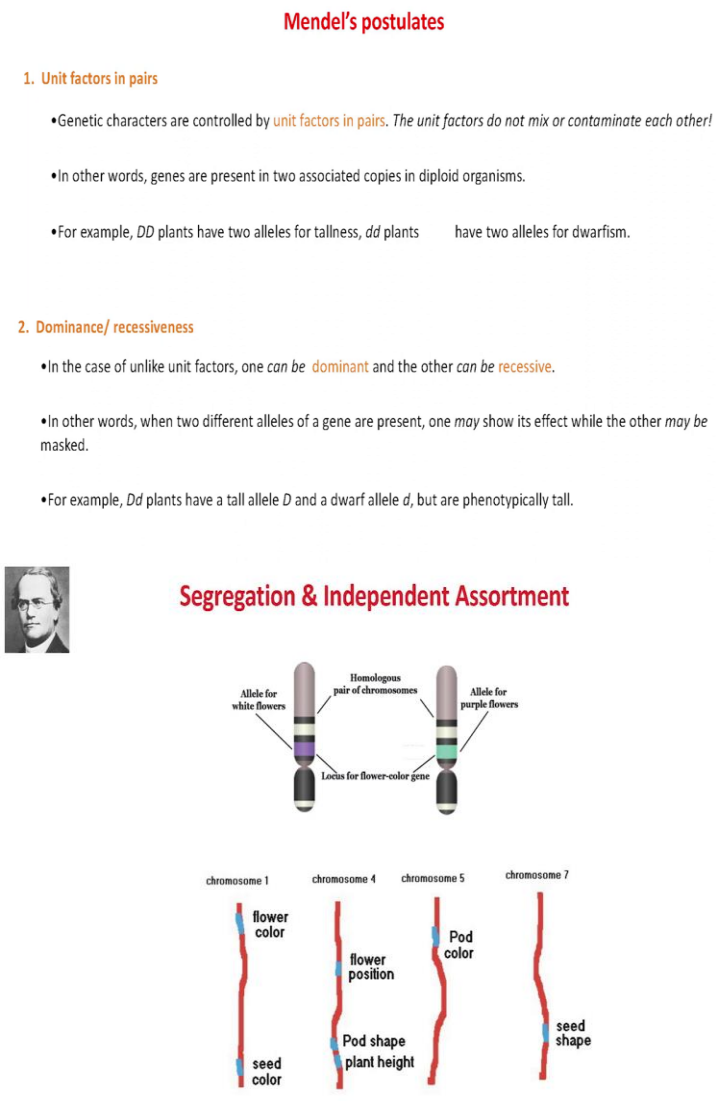

So, now, what I want you to take away from this class is reframing or looking very carefully at what Mendel said, but looking at it from a modern biological sense, what are alleles, what are genes where they are placed and Mendel's postulates which is segregation, which is basically to do with a alleles separating.

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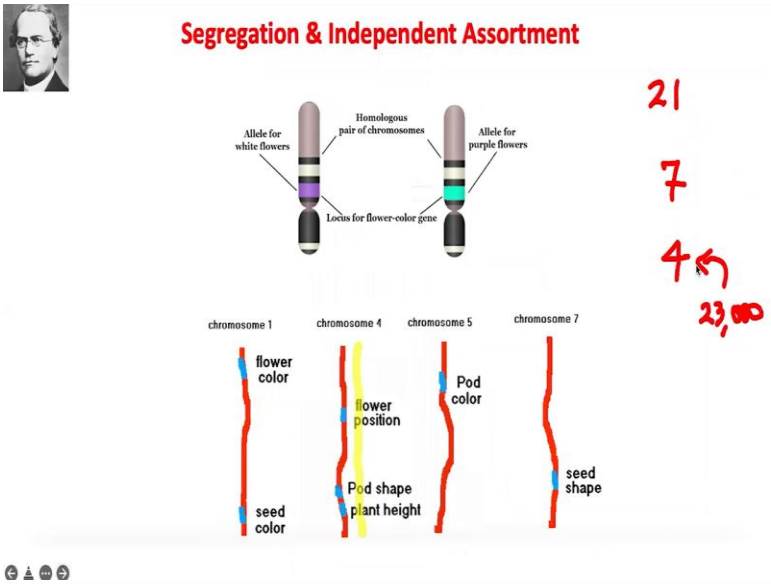

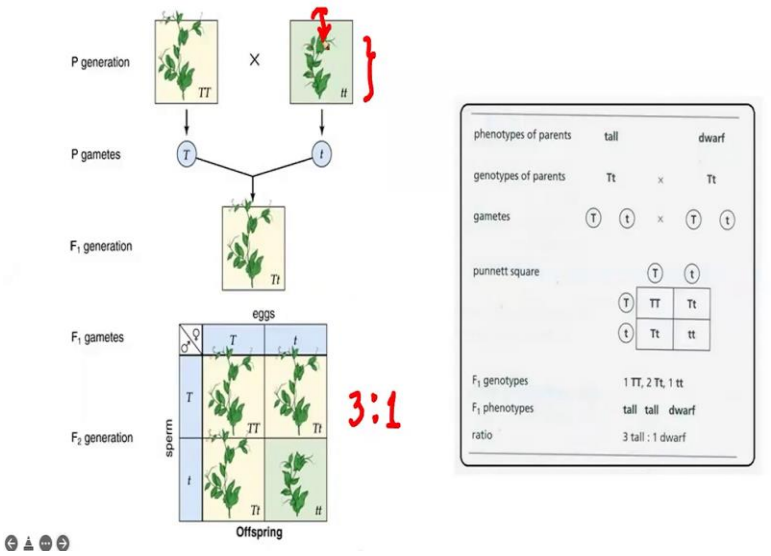

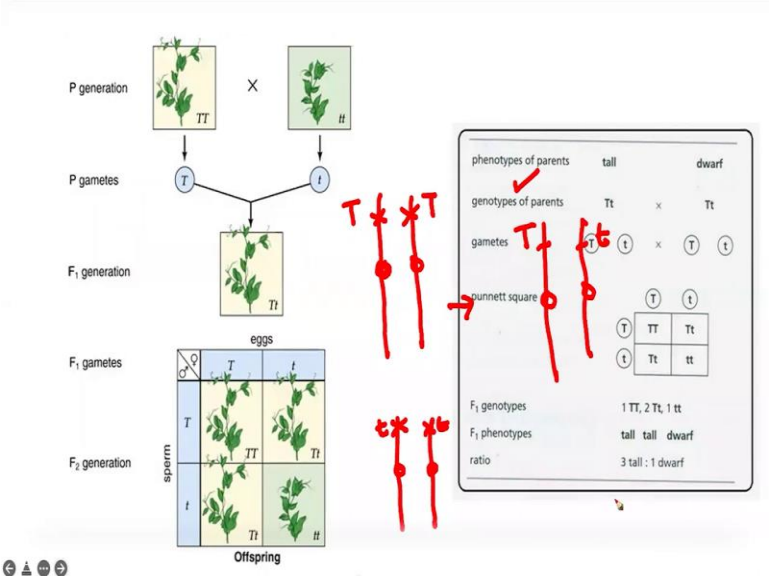

Independent Assortment, which has to do with genes which are on different chromosomes, if they are on different chromosomes, they will assort independently. Now, two genes on the same chromosome may not influence each other, but they may not assort independently because when this chromosome, if there is a second homologous chromosome over here, what will end up happening is that pod shape plant height and flower position will basically be linked.

And because they are linked, they will move to this whole set will move to a single sperm or a single egg. So, now, hopefully you see the relevance of chromosomes. Humans, let us say have humans have 21 independent linked entities, the entire genetic information for god knows what reasons have been divided into 21 sets.

Each set contains a set of anywhere between a few 100 to a few 1000 genes, all linked together physically. Pea has only 7. So, it has 7 sets, I as such study the fruit fly, the fruit fly has only 4 pairs of chromosomes. So, they only for 4 sets and a fruit fly has again around 23,000 genes. So, these 23,000 genes are divided into these 4 sets, which are linked, and they move together during mitosis and meiosis.

So, now let us come to the part which I think is the tricky part, go to dominance and, recessiveness and to do go to dominance and recessiveness, let us go to a classical Mendelian cross, I hope all of you have seen this at least once in school in either 9th 10th 11th or 12th standard. The cross is very simple. What Mendel did is he spent a lot of time making what are called as pure lines. Which are basically lines which bread true.

So, he had plants, which were, let us say grown on the left hand corner of the field, which were always tall. And he also grew by crossing dwarf plants together again and again and again, plants which were always dwarf. Now, in his primary cross called as a monohybrid cross, he took these true breeding tall plants, then he took the true breeding dwarf plants and he crossed them together.

And in the next generation, he found that all plants were tall, when there was no sign of any dwarf plant. Then he selfed this tall plant. Now a, true breeding tall plants always give tall plants. But this particular tall plant, which was a hybrid of the tall and the dwarf plant, not showing any characteristic over here, when crossed together showed and this is all stuff you have studied in school showed a basic ratio of 3 is to 1 for tall plants is to dwarf plants.

So, the dwarf characteristic magically reappeared in the F2 generation, but it was not seen in the F1 generation. And the generic logic is that if you say that a single gene is responsible for the height difference between these plants, dwarf versus tall, nobody is saying that the single gene is responsible for the total height of the plant, it is just shorter or longer. That is the only difference.

And if we say that this gene can be assigned a name, and we the name we assigned this gene is the tall gene, and this tall gene is somewhere on one of the chromosomes of the pea plant. And we can argue that it is let us say, over here in the pea plant, then we say that the true breeding plant has two alleles T T and the dwarf plant also has two alleles of the same gene, which is t t. Remember T T, small t small t, capital T capital T are the same gene in the same location on chromosomes.

And what is happening when you cross the capital T capital T with a small t small t you are bringing together these two alleles and I will draw this over here in the same plant. So, you have one capital T and you have one small t however, the phenotype of a combination of these two discrete alleles is still a tall plant, which means that the capital T dominates over the small t, you do not see any dwarf plants.

However, when you do a F 2 generation you can get back the alleles and a simple punnett square which we will again go through tells you that if you use simple ideas of gametes being independent, and the gametes are independent because of segregation. Because both these alleles

go to independent sperms and eggs, there is a simple mathematical cross of Punnett square tells you that the expected ratio if these independent alleles are not mixing is 3 is to 1.