LINKED GENES

Genes are found on chromosomes, right? So if some genes are on the same chromosome why aren't they inherited all linked together as a package deal on the same chromosome? (But hey, that would be a contradiction of Mendel's law of Independent Assortment, would it not?!)

As a matter of fact – some genes are linked in this manner. William Bateson was the famous scientist who "rediscovered" Mendel, who invented the term "Genetics" and was the first to recognize that some genes are linked.

Numerous genes are found on the same chromosome.

Genes on same chromosome are described as being in same Linkage Groups and inherited together. For example, red hair and freckles are closely linked; you rarely get one without the other.

Such genes are unable to assort independently- eg. will not show F1 self-cross 9:3:3:1 ratio.

Let's assume mugwumps possess two genes: Attitude vs shyness (A vs a) and Big vs. Small Feet (B vs. b).

Scenario 1 - Let's assume NO linkage:
a dihybrid male is test-crossed with a homozygous recessive shy small foot.

	AB	Ab	aB	ab
ab	AaBb	Aabb	aaBb	aabb

This is what Mendel would expect according to the law of independent assortment.

Scenario 2 - In fact, these genes are closely linked on same chromosome – assume complete linkage:

A purebred attitudinal large footed male crosses with a homozygous recessive shy small foot.

The F1 all are $\frac{A\ \ B}{a\ \ b}$ notice the allele linkages from parents

An F1 male is test-crossed with a homozygous recessive female. Notice that the male can only produce two kinds of sperm – not four as before when there was no linkage:

	$\frac{A\ \ B}{\ }$	$\frac{a\ \ b}{\ }$
$\frac{a\ \ b}{\ }$	$\frac{A\ \ B}{a\ \ b}$	$\frac{a\ \ b}{a\ \ b}$

This is not what Mendel would expect - independent assortment failed to occur because of linkage.

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Scenario 3 – In fact such a Mugwump test cross produces offspring with the following ratio

47.5 % attitudinal, large footed
47.5 % shy, small footed
2.5% attitudinal, small footed
2.5% shy, large footed

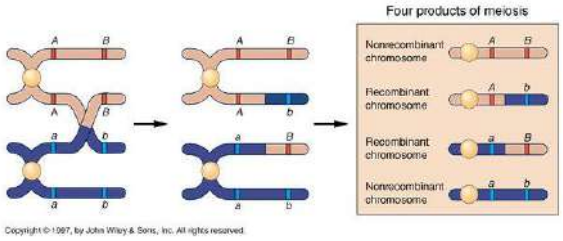
How is this possible? Clearly most of the time – the linked genes stay linked. But rarely (5% of the time) some independent assortment does take place.

	A B (47.5%)	a b (47.5%)	A b (2.5%)	a B (2.5%)
A B / a b	A B / a b	a b / a b	A b / a b	a B / a b

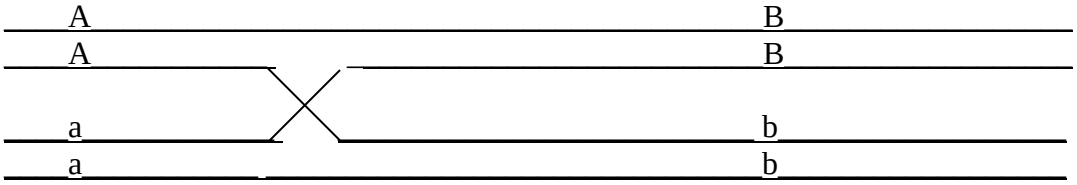
Remember – these insights were taking place before anybody understood DNA and chromosomes.

Morgan (working with fruit flies) was the first to demonstrate that genes are carried on chromosomes and are the mechanical basis of heredity.

Imagine crossing over or swapping of DNA during the production of "sex cells" or gametes:



Or in the case of our Mugwumps:



What would be the outcome of such cross-over events?

A B and a b most of the time

But on rare occasion – we also see
A b and a B some of the time - Recombinant chromosomes!

The closer together the genes – the less likely we will see such a cross-over during the test-cross.
The further apart the genes – the more likely we will see such a cross-over during the test-cross.

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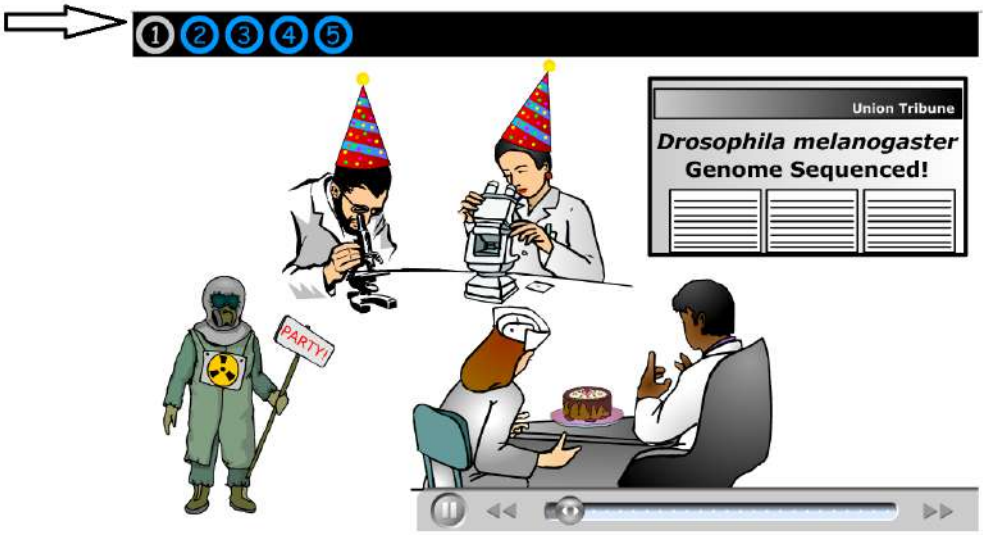
Morgan's lab first figured out that recombination could allow geneticists to map genes on chromosomes. The Mugwump genes are 5 centiMorgans cM apart.(recombinantion happens with a 5% probability)

Gene mapping occurred long before DNA sequencing took place because of Morgan's insight.

Review with these Links (these are copyrighted – so access accordingly): **http://tinyurl.com/82l4usn**

With regards to the multi-media – note there are FIVE separate links to be accessed by clicking numbers above:



Now on to some problems…

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