

Linkage *Drosophila*

prpr vgvg (purple eye color, vestigial wings) X *pr⁺pr⁺ vg⁺vg⁺* (red eyes, normal wings)



prpr⁺ vgvg⁺ X *prpr vgvg*

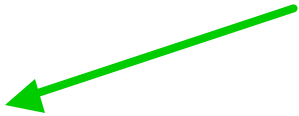
Parental	{	<i>pr⁺ vg⁺</i>	1339
		<i>pr vg</i>	1195
Recombinant	{	<i>pr⁺ vg</i>	151
		<i>pr vg⁺</i>	154
			2839

$$\text{Recombination frequency} = \frac{\# \text{ recombinant}}{\text{Total}} \times 100 = \frac{305}{2839} \times 100 = \underline{10.7\%}$$

Linkage

scsc ecec vgvg (scute bristles, echinus eye, vestigial wing) X *sc⁺sc⁺ ec⁺ec⁺ vg⁺vg⁺*

sc/+ ec/+ vg/+ X *scsc ecec vgvg*



<i>sc</i>	<i>ec</i>	<i>vg</i>	235
+	+	+	241
<i>sc</i>	<i>ec</i>	+	243
+	+	<i>vg</i>	233
<i>sc</i>	+	<i>vg</i>	12
+	<i>ec</i>	+	14
<i>sc</i>	+	+	14
+	<i>ec</i>	<i>vg</i>	16

1008

Not a

1:1:1:1:1:1:1:1

Linkage

sc/+ ec/+ vg/+ X *scsc ecec vgvg*

Are *sc* and *ec* linked?

Parental	<i>sc</i>	<i>ec</i>	<i>vg</i>	235
	+	+	+	241
	<i>sc</i>	<i>ec</i>	+	243
	+	+	<i>vg</i>	233
Recombinant	<i>sc</i>	+	<i>vg</i>	12
	+	<i>ec</i>	+	14
	<i>sc</i>	+	+	14
	+	<i>ec</i>	<i>vg</i>	16
				1008

%recombination =

$$[(12 + 14 + 14 + 16)/1008] \times 100 =$$

5.5%

sc *ec*

5.5 m.u.

Linkage

scsc ecec cvcv (scute bristles, echinus eye, crossvein wing) X ++ ++ ++

sc/+ ec/+ cv/+ X *scsc ecec cvcv*



<i>sc</i>	<i>ec</i>	<i>cv</i>	417
+	+	+	430
<i>sc</i>	<i>ec</i>	+	44
+	+	<i>cv</i>	37
<i>sc</i>	+	+	25
+	<i>ec</i>	<i>cv</i>	29
<hr/>			982

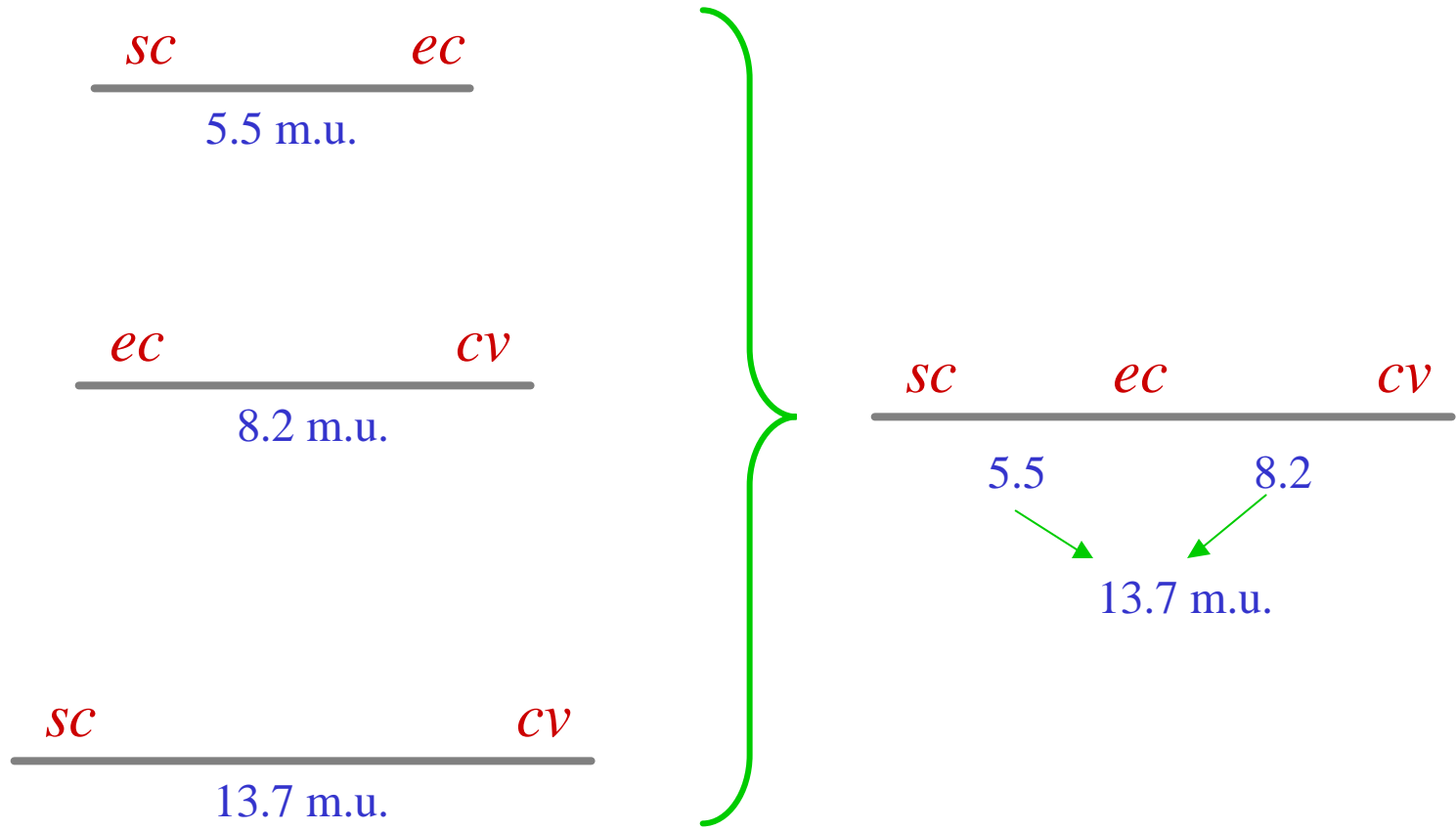
Not a 1:1:1:1

sc and *cv* show linkage

ec and *cv* show linkage

and we already know that *sc* and *ec* are linked by 5.5m.u.

Linkage Map

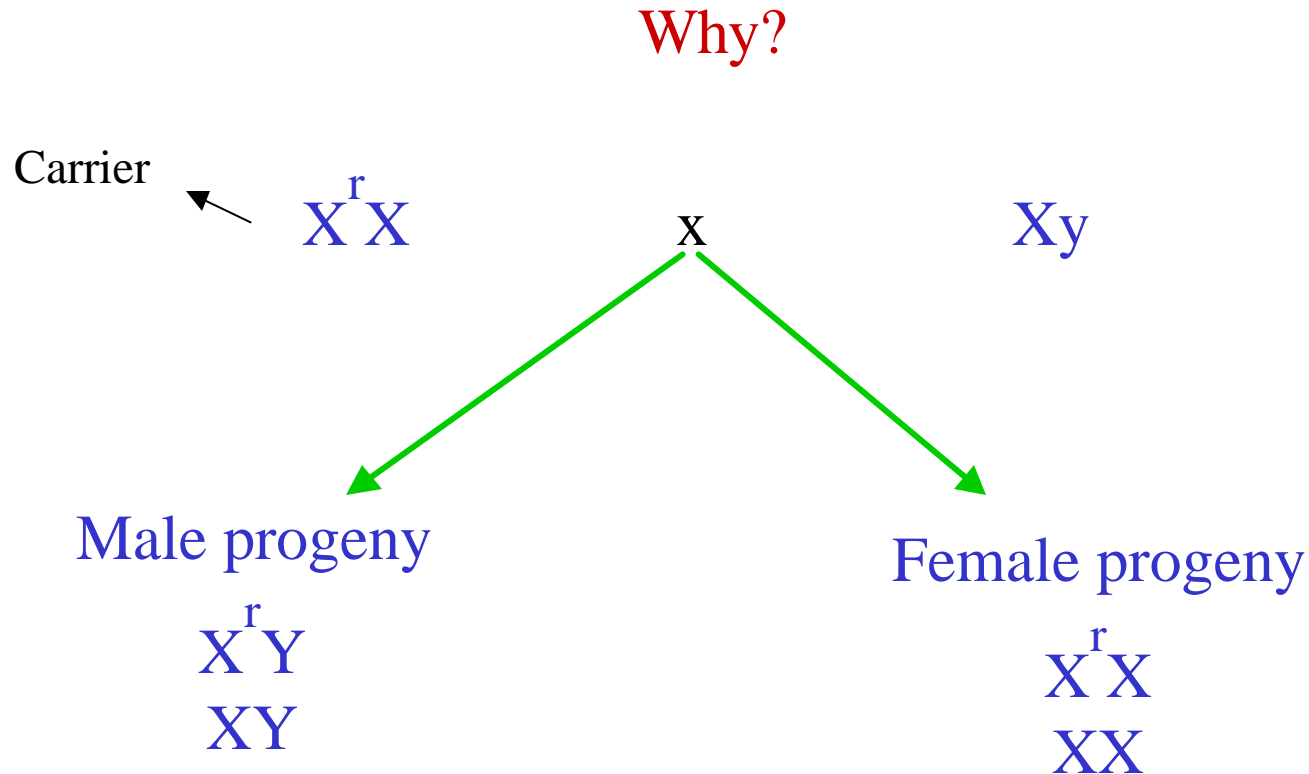


Sex Chromosome Linkage

- All genes discussed were linked on non-sex (autosomal) chromosomes
- **Linkage** describes the association of genes on the same chromosome
- Sex-linked genes have been identified and do not require testcross!!!
- **Sex-linkage** describes the association of genes with an X chromosome or other sex-determining chromosomes

Sex Chromosome Linkage

- Sex-linked genes have been identified and do not require testcross!!!



Sex Chromosome Linkage

Some disease-related genes on human X chromosome

(some of these conditions may be inherited through genes on the autosomes as well).

Condition	D or r	Description
Green color blindness	r	Abnormal green cone pigments in retina
Megalocornea	r	Enlarged cornea
Hemophilia A	r	Absent clotting factor VIII
Hemophilia B	r	Absent clotting factor IX
Amelogenesis imperfecta	D	Abnormal tooth enamel
Ichthyosis	r	Rough, scaly skin on scalp, ears, neck, abdomen, and legs

Criteria for an X-linked dominant trait

- Expressed in female in once copy
- Expressed much more severely in male
- High rates of miscarriage, due to early lethality in males

