

Genetic Crosses Worksheet – Tomatoes Answer Key

1. In tomatoes, yellow flowers (F) are dominant to white flowers (f) and thick stems (T) are dominant to thin stems (t).

Pollen from a tomato with thick stems and white flowers pollinates a tomato with thin stems and yellow flowers. The F_1 all have thick stems and yellow flowers.

a) When you perform a testcross on the F_1 s, if the genes segregate independently, what phenotypes do you expect and in what ratio do you expect these phenotypes to occur? *Show your work.*

This question asks you to identify the **phenotypes of F_2 s**. We should start from the individuals involved in the very first cross, the parents.

Based on the phenotypes of the parents, let us **first identify the part of their genotypes that we can determine for certain**. White flower is recessive so the parent with this phenotype must have ff genotype for the flower colour; likewise, the parent with thin stem, which is a recessive phenotype, must have tt genotype.

As for the dominant phenotypes of the parents (yellow flower and thick stem), we do not know yet their genotypes (could be homozygous [FF; TT] or heterozygous [Ff, Tt]). For them, we need to look at their progeny F_1 s.

All F_1 s show dominant phenotypes on both traits: thick stem and yellow flowers. Yet for each trait, one of the parents had the homozygous recessive genotype. For **ALL** the F_1 s to show dominant phenotype, we know that the other parent must have homozygous dominant phenotype.

The parent genotypes are now known:

The one with thick stem, white flower: TTff.

The one with thin stem, yellow flower: ttFF

The F_1 s genotype would therefore be TtFt. Verify this with the phenotype of F_1 s to see if it fits; it does.

A testcross means that F_1 s were crossed with homozygous recessive individuals for both phenotypes, whose genotype is ttff.

The rest should be easy by using a Punnett square

Gametes of the F_1 s				
	TF	Tf	tF	tf
tf	TtFt	Ttff	ttFf	ttff
phenotypes of F_2 s	thick stem, Yellow flower	Thick stem white flower	thin stem Yellow flower	thin stem White flower
ratio	1:	1:	1:	1

b) When you perform a testcross on the F_1 s, if the genes are linked with no crossing over, what phenotypes do you expect and in what ratio do you expect these phenotypes to occur? *Show your work. (Highly recommend drawing the chromosomes).*

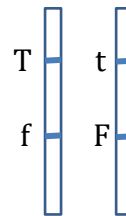
For the linked genes, the first part is identical to the one above, determining the genotypes of the parents for the original cross. The results are still identical to the one above

The one with thick stem, white flower: TTff.

The one with thin stem, yellow flower: ttFF

Even though the genotype of the F_1 s is still the same as above, TtFf, we now need to know which alleles are linked to which (i.e., whether T is linked to F or f, and the same goes for F). For each pair of homologous chromosomes in the F_1 , one come from Mom and the other came from Dad.

The thick stem white flower parent has TTff, while the other has ttFF. Based on this piece of information, we can conclude that T is linked with f (same individual) and t is linked with F.
The F_1 cell in G1 phase should look like this



The possible gametes this F_1 can produce, when no crossing over occurs, should only be two: Tf and tF (see the chromosome diagram above)

	Tf	tF
tf	Ttff	ttFf
Phenotypes of F_2 s	Thick stem, white flower	Thin stem, yellow flower
ratio	1:	1

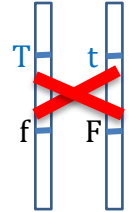
Note that the phenotypes of F_2 s are the same as the original parent, even though the genotypes are not identical

c) What results do you expect from the testcross if the genes are linked and crossing-over occurred? Crossing over can happen. Show your work. (*Highly recommend drawing the chromosomes*).

If crossing over occurs between the two genes, we would expect to have the F_1 s produce the same variety of gametes as the one in question a) above, as the crossing over will allow F_1 s to produce recombinant gametes (i.e., t and f end up on the same chromosome, and T and F on the same chromosome): tf and TF

Non-sister chromatids go through crossing over and create recombinant gamete

The F_2 s will have the same variety of phenotypes as the answer (a) above



d) What would happen to the relative frequency of the recombinant phenotypes as the distance between the linked genes increased?

Depending on the distance between the two genes on the chromosome, the recombinant phenotypes should be less abundant than the parental phenotypes (shown in answer b); the further the distance between the two genes, the higher the percentage of recombinant phenotypes would be in F_2 s.