EPISTASIS SUMMARY

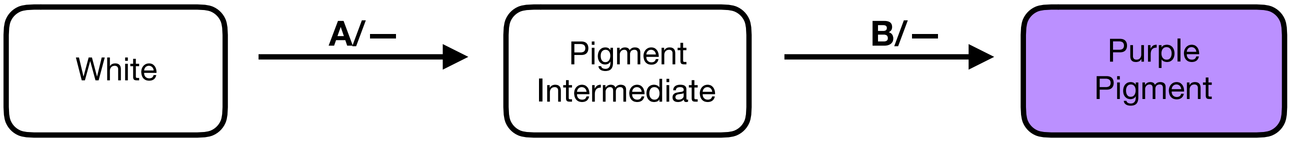
- Describes how one gene directly inhibits the phenotypic output of another gene

- There are at least 10 types of epistasis (we've studied 3), each producing distinct phenotype ratios when we do a **dihybrid cross**:
    - Recessive epistasis (9:4:3)
    - Duplicative Recessive epistasis (9:7)
    - Dominant epistasis (12:3:1)

MODELING EPISTASIS: DUPLICATIVE RECESSIVE (aka GENES IN SAME PATHWAY)

In our Complementation Test guide, we found that 2 genes (A and B) controlled flower color. Flowers are normally purple, but a recessive mutation in either gene will turn the flower white. How?

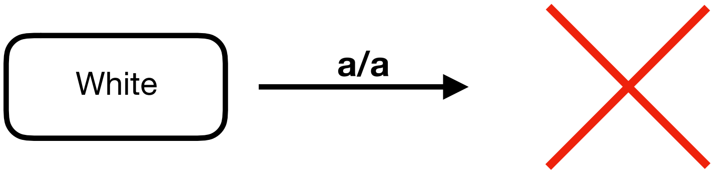
Consider this pigmentation pathway:



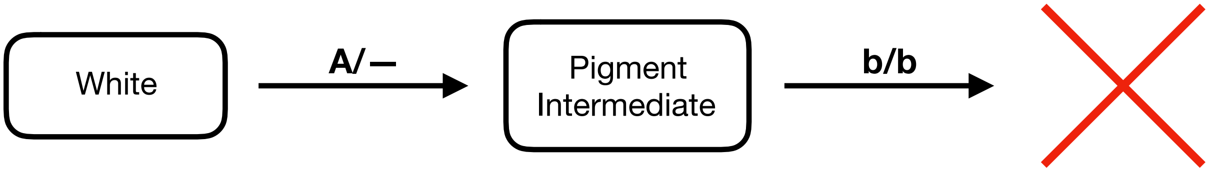
A colorless (white) precursor to pigment is converted by gene A to an intermediate molecule, which is then converted by gene B to the purple pigment.

Note that this is a linear pathway: being homozygous recessive for either gene prevents the purple product from being made.

In this example, White is recessively epistatic to Purple



In this example, White is again recessively epistatic to Purple



Remember, in a normal **dihybrid cross** we expect a 9:3:3:1 ratio, as follows:

9	3	3	1
A/—; B/—	A/—; b/b	a/a; B/—	a/a; b/b

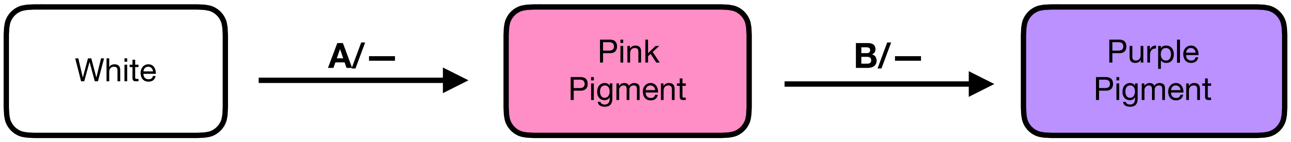
However, Only A/—; B/— produces a purple flower; all the others make mutant white flowers.

Duplicative Recessive epistasis thus produces a 9:7 phenotype ratio.

MODELING EPISTASIS: RECESSIVE

This mode of epistasis functions just like the above, but it is not duplicative. An easy example is seen if we propose a new phenotype class for our flowers: pink petal color.

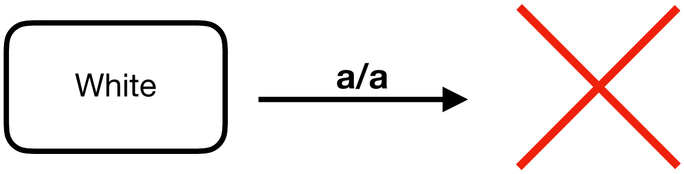
Consider this pigmentation pathway:



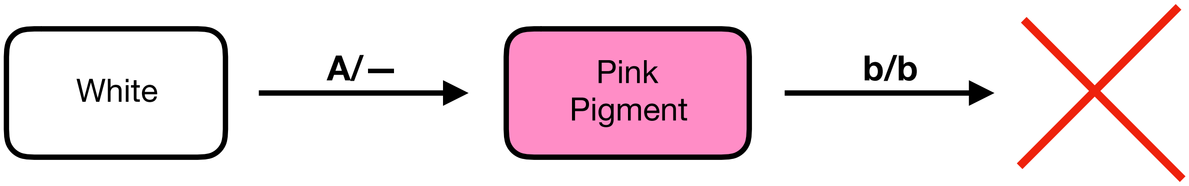
A colorless (white) precursor to pigment is converted by gene A to pink pigment, which is then converted by gene B to the purple pigment.

Again, this is a linear pathway: being homozygous recessive for gene A prevents the pink or purple pigments from being made, while being homozygous recessive for gene B prevents purple from being made.

In this example, White is recessively epistatic to Purple



In this example, mutant b/b fails to produce purple color



Remember, in a normal **dihybrid cross** we expect a 9:3:3:1 ratio, as follows:

9	3	3	1
A/—; B/—	A/—; b/b	a/a; B/—	a/a; b/b

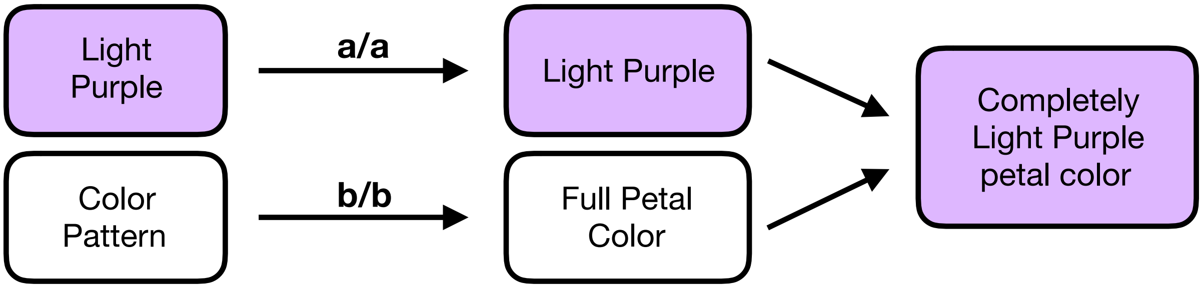
However, Only A/—; B/— produces a purple flower; homozygous recessive for "B" results in pink flowers, while anything homozygous recessive for "A" gives colorless (white) flowers.

Recessive epistasis thus produces a 9:4:3 phenotype ratio.

MODELING EPISTASIS: DOMINANT

This is the most complicated form of epistasis we have studied, usually because each gene specifies a different phenotype restriction.

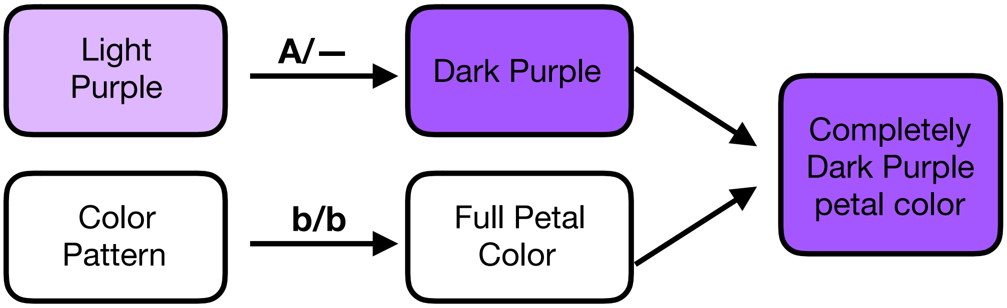
Consider the functions of genes "A" and "B" in a new set of flowers:



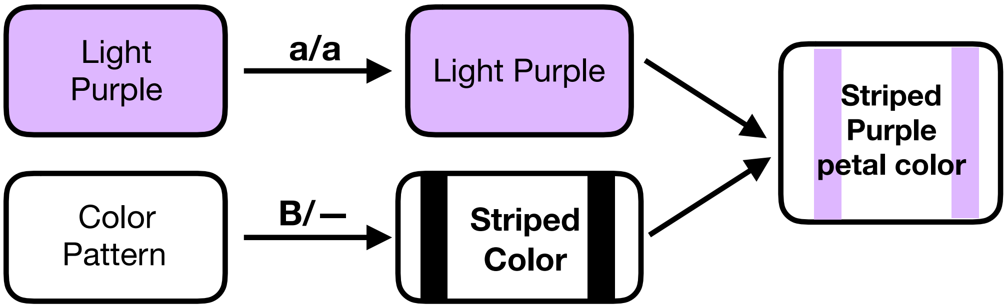
Gene "A" normally creates dark purple pigment, while gene "B" makes that pigment appear throughout all the flower petal cells.

Dominant mutations can change these results in several ways:

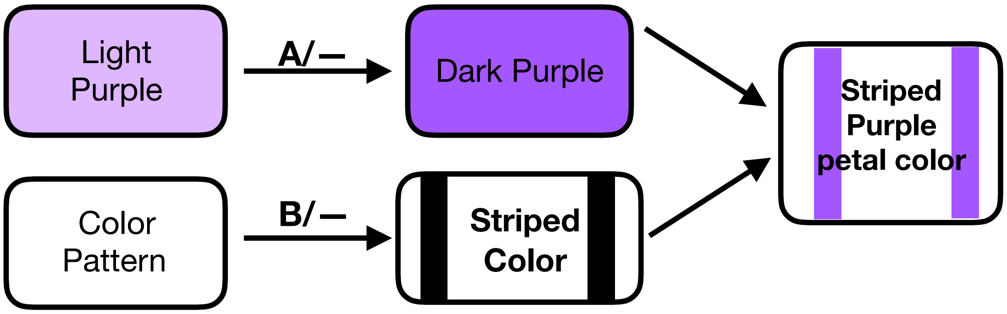
In this example, Dominant "A" makes the flower dark purple; no epistasis here!



In this example, Striped pattern is Dominantly Epistatic to Purple



In this example, Striped pattern is Dominantly Epistatic to Purple



Remember, in a normal **dihybrid cross** we expect a 9:3:3:1 ratio, as follows:

9	3	3	1
▮ A/—; B/— ▮	A/—; b/b	▯ a/a; B/— ▯	a/a; b/b

In terms of epistasis, we see that striped epistatically controls flower petal color in a dominant manner.

Dominant epistasis thus produces a 12:3:1 phenotype ratio.