COMPLEMENTATION TEST SUMMARY

- Used to determine how many genes are controlling a specific mutant trait
- Requires both parents to be pure breeding (homozygous) for the mutant trait
- Groups offspring phenotypes into "complementation groups", each representing 1 trait-controlling gene.

THE PROBLEM: How Many Genes?

Imagine a New Hampshire flower's most common phenotype (called the "wildtype") is purple petals. However, you discover some mutant flowers that are white.

The easiest explanation for this mutation is that the white flowers have a mutant allele for the flower-color gene. If we assume complete dominance:

Phenotype	Genotypes for Gene A
Purple flower	A/—
White flower	a/a

However, it is also possible that more than 1 gene controls flower color:

Phenotype	Genotypes for Gene A	Genotypes for Gene B
Purple flower	A/—	B/—
White flower	a/a	b/b

Complementation Tests tell us if is flower color impacted by 1 or more genes.

THE METHOD: Doing a Complementation Test (1 gene answer)

1. Remember that parents MUST be pure breeding (homozygous) for the mutant phenotype.

2. Set up each parent in a complementation table:

	NH White Flower 1	**NH White Flower 2**
NH White Flower 1		
NH White Flower 2		

3. Mate these parents, and record the phenotypes of their offspring:

	NH White Flower 1	**NH White Flower 2**
NH White Flower 1		white
NH White Flower 2		

Notice that we only filled in one cell; this is because we are not mating a flower to itself, and we don't need to depict the same mating 2 times.

4. Identify Complementation Groups.
If the offspring are mutants, put both parents in the same group:

NH White Flower 1
NH White Flower 2

Complementation group 1

These parents produced mutant (white) offspring, so the parents have mutant alleles **in one gene**.

THE RATIONALE:

Remember, if only 1 gene is controlling the flower color, its simple to explain why all offspring are mutants. Consider the punnett square:

Since the parents are pure-breeding mutants, crossing them results in all homozygous mutant offspring.

	a	**a**
a	**a/a**	**a/a**
a	**a/a**	**a/a**

THE METHOD: Doing a Complementation Test (3 gene answer)

We have identified more white flowers of the same species, but these are from Connecticut. Are these white flowers mutated in the same gene as our New Hampshire flowers?

Let's do another Complementation Test:

	NH White Flower 1	**NH White Flower 2**	**CT White Flower 1**	**CT White Flower 2**
NH White Flower 1		white	purple	purple
NH White Flower 2			purple	purple
CT White Flower 1				white
CT White Flower 2				

Now Sort our complementation groups:

NH White Flower 1
NH White Flower 2

CT White Flower 1
CT White Flower 2

The CT flowers and NH flowers make wildtype (purple) flowers when crossed, indicating that mutations in **2 different genes** are responsible.

THE RATIONALE:
How do these results tell us that 2 different genes are controlling flower color?
- We know all parents are homozygous for flower color
- if 2 genes are involved, the following is possible:

Parent	Genotype for Genes A & B
NH White Flower 1	a/a; B/B
CT White Flower 1	A/A; b/b

What happens when we cross these parents? Consider the punnett squares:

Notice that all offspring are heterozygotes for both genes: A/a; B/b

Thus, the dominant allele for both genes prevents the mutation, and we get a wildtype (purple) color.

	a	a
A	A/a	A/a
A	A/a	A/a

	b	b
B	B/b	B/b
B	B/b	B/b

You may have noticed that being homozygous recessive for one gene makes mutant white offspring, regardless of their genotype for the second gene.

This is an example of **Duplicate recessive Epistasis.** See the Epistasis guide for a deeper look at these flowers!