

otherwise, you couldn't grow them!) You perform pairwise infections with each of your mutant bacteriophage strains and get the following results:

(+) = pair of phages lysed host cells, (-) = pair of phages failed to lyse host cells.

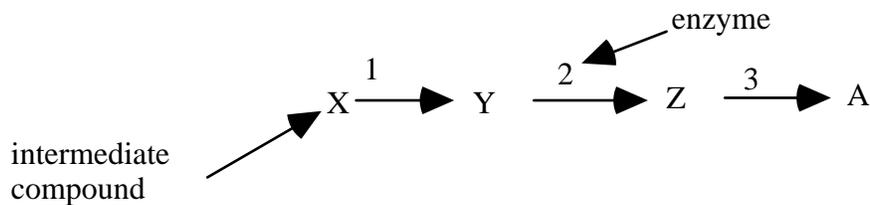
	m1	m2	m3	m4	m5	m6	m7	m8	wt
m1	-	+	+	-	-	+	+	+	+
m2		-	+	+	+	+	+	+	+
m3			-	+	+	-	-	-	+
m4				-	-	+	+	+	+
m5					-	+	+	+	+
m6						-	-	-	+
m7							-	-	+
m8								-	+
wt									+

5. What are the complementation groups and how many genes have you identified?

### C. Epistasis

#### I. Example 1—A pathway

Given the following pathway for the synthesis of the essential compound A, where letters represent intermediate compounds and numbers represent enzymes:



Mutants with defective genes 1, 2, or 3 (m1, m2, m3) will require A to grow on minimal medium.

1. What intermediate will build up in the following mutants:

m1:

m2:

m3:

2. What intermediate(s) will the following mutants grow on?

m1:

m2:

m3:

3. What intermediate will build up in the following double mutants?

m1,m2:

m2,m3:

m1,m3:

4. What intermediate(s) will the following double mutants grow on?

m1,m2:

m2,m3:

m1,m3:

II. Example 2—Arg pathway

You are studying the biosynthesis of the amino acid arginine. You have strains (m1, m2, m3, m4) with mutations in four different genes. You can add as a supplement to the medium three potential intermediates (A, B, C). You plate your strains on plates with the following media and see if they grow (+) or not (-).

<b>Strain</b>	<b>Medium</b>				
	min	min + A	min + B	min + C	min + arg
wild-type	+	+	+	+	+
m1	-	-	+	-	+
m2	-	-	-	-	+
m3	-	+	+	-	+
m4	-	+	+	+	+

5. What is the order of enzymes and intermediates in the pathway?

6. What supplement(s) would the double mutant m1,m4 grow on?

### III. Example 3—pigment synthesis

You are studying the pathway of pigment synthesis in the fictitious bacterium, *Bacterium colorificus*. Wild-type bacteria are red. You have three mutant strains, with altered colors. Below is the chart of the wild type, three original mutants, and three double mutants:

<u>Genotype</u>	<u>Color Phenotype</u>
m1 <sup>+</sup> m2 <sup>+</sup> m3 <sup>+</sup>	red (wild-type)
m1 <sup>-</sup> m2 <sup>+</sup> m3 <sup>+</sup>	orange
m1 <sup>+</sup> m2 <sup>-</sup> m3 <sup>+</sup>	yellow
m1 <sup>+</sup> m2 <sup>+</sup> m3 <sup>-</sup>	colorless
m1 <sup>-</sup> m2 <sup>-</sup> m3 <sup>+</sup>	orange
m1 <sup>+</sup> m2 <sup>-</sup> m3 <sup>-</sup>	colorless
m1 <sup>-</sup> m2 <sup>+</sup> m3 <sup>-</sup>	colorless

7. Based on this information, determine the order of the enzymes and intermediates in this pathway.

otherwise, you couldn't grow them!) You perform pairwise infections with each of your mutant bacteriophage strains and get the following results:

(+) = pair of phages lysed host cells, (-) = pair of phages failed to lyse host cells.

	m1	m2	m3	m4	m5	m6	m7	m8	wt
m1	-	+	+	-	-	+	+	+	+
m2		-	+	+	+	+	+	+	+
m3			-	+	+	-	-	-	+
m4				-	-	+	+	+	+
m5					-	+	+	+	+
m6						-	-	-	+
m7							-	-	+
m8								-	+
wt									+

5. What are the complementation groups and how many genes have you identified?

There are 3 complementation groups identifying 3 genes:

m1, m4, and m5 are in gene 1

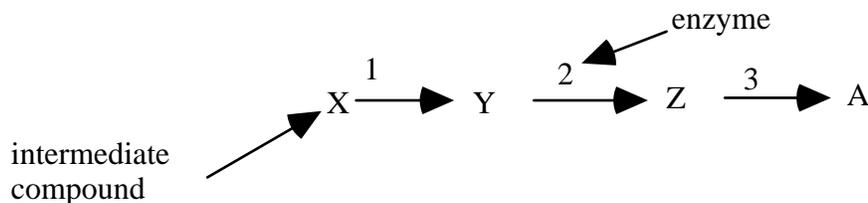
m2 is in gene 2

m3, m6, m7, and m8 are in gene 3

## C. Epistasis

### I. Example 1—A pathway

Given the following pathway for the synthesis of the essential compound A, where letters represent intermediate compounds and numbers represent enzymes:



Mutants with defective genes 1, 2, or 3 (m1, m2, m3) will require A to grow on minimal medium.

1. What intermediate will build up in the following mutants:

m1: X

m2: Y

m3: Z

2. What intermediate(s) will the following mutants grow on?

m1: Y, Z, or A

m2: Z or A

m3: A only

3. What intermediate will build up in the following double mutants?

m1,m2:X

m2,m3:Y

m1,m3:X

*When ordering genes in biochemical pathways based on the build up of intermediates the observed phenotype is conferred by the gene that comes earlier in the pathway.*

4. What intermediate(s) will the following double mutants grow on?

m1,m2: Z or A

m2,m3: A

m1,m3: A

*When ordering genes in biochemical pathways based on feeding requirements for growth, the observed phenotype is conferred by the gene that comes later in the pathway.*

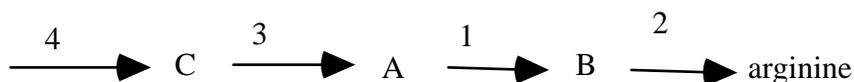
## II. Example 2—Arg pathway

You are studying the biosynthesis of the amino acid arginine. You have strains (m1, m2, m3, m4) with mutations in four different genes. You can add as a supplement to the medium three potential intermediates (A, B, C). You plate your strains on plates with the following media and see if they grow (+) or not (-).

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m2	-	-	-	-	+
m3	-	+	+	-	+
m4	-	+	+	+	+

5. What is the order of enzymes and intermediates in the pathway?

*The pathway is:*



6. What supplement(s) would the double mutant m1,m4 grow on?

*m1,m4 would grow on B or arginine.*

### III. Example 3—pigment synthesis

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m1 <sup>-</sup> m2 <sup>+</sup> m3 <sup>-</sup>	colorless

7. Based on this information, determine the order of the enzymes and intermediates in this pathway.

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