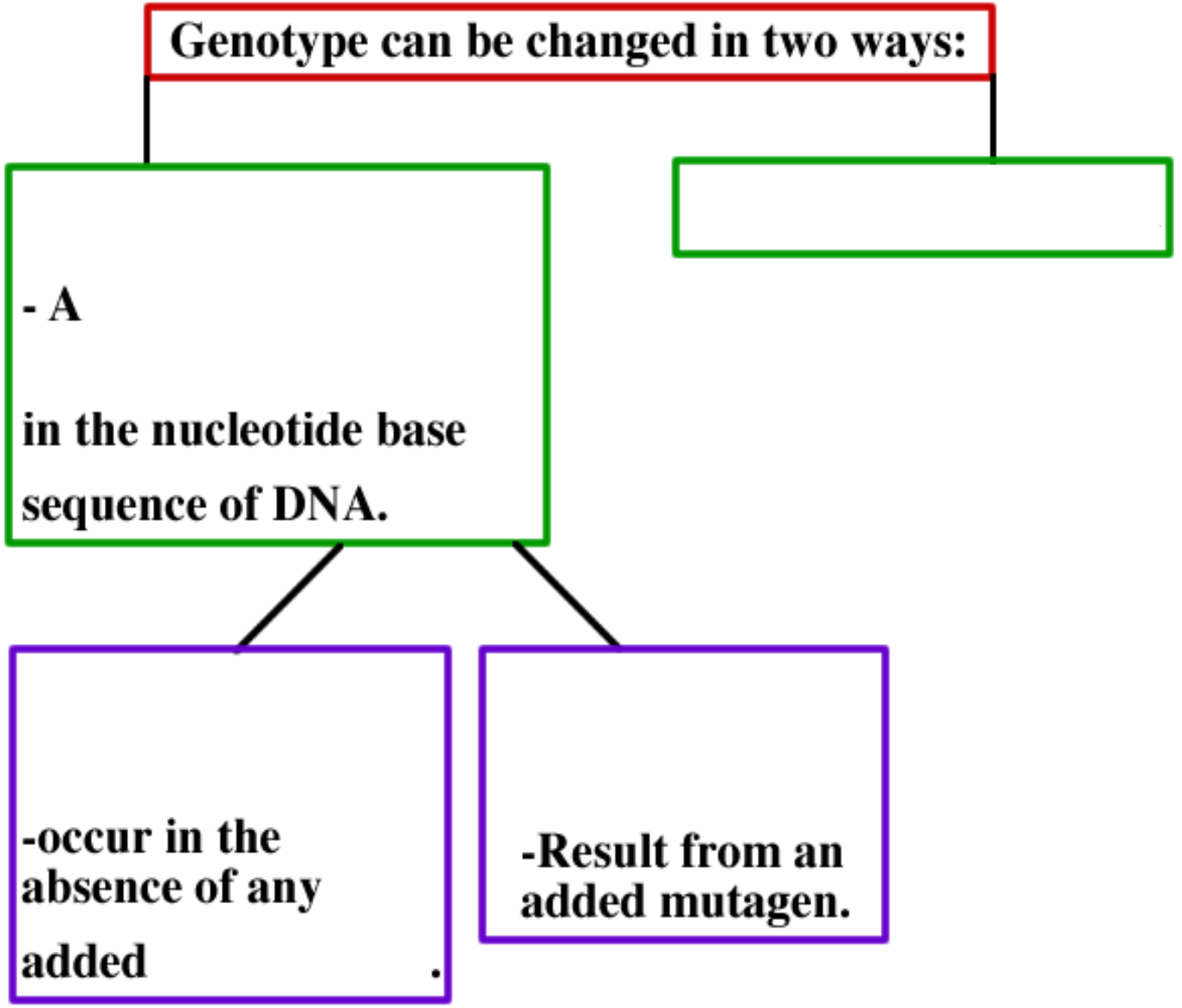
Lecture 16: Mutation

I. Genetic diversity in microorganisms - created by .



A. Mutation

1. Types of spontaneous mutation

a. Base substitution

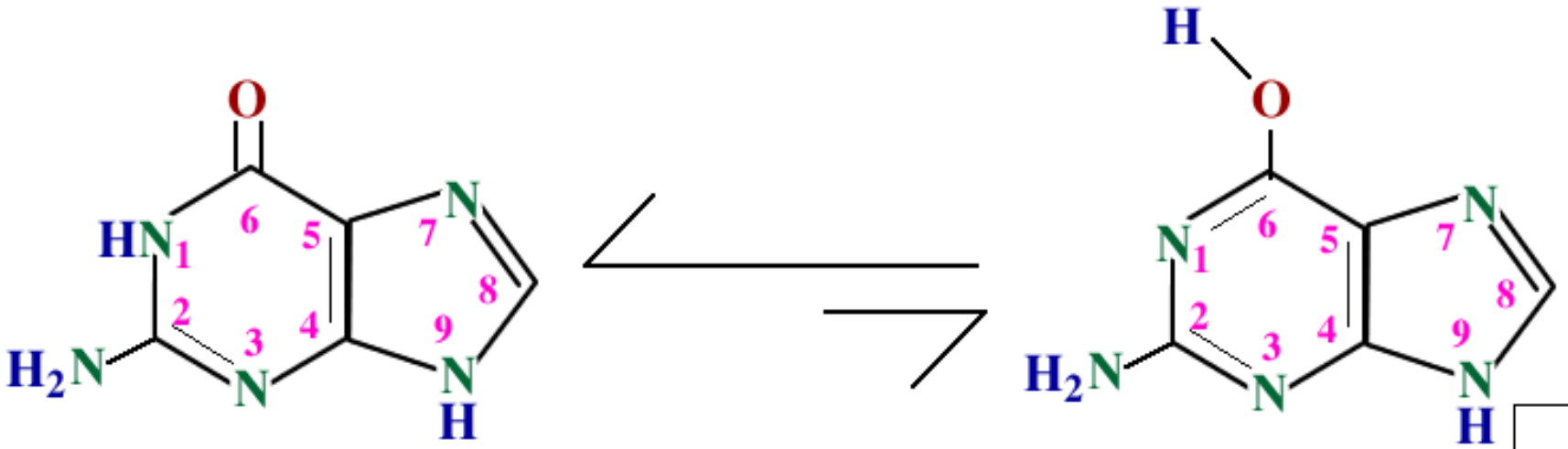
1.) During DNA synthesis, DNA polymerase

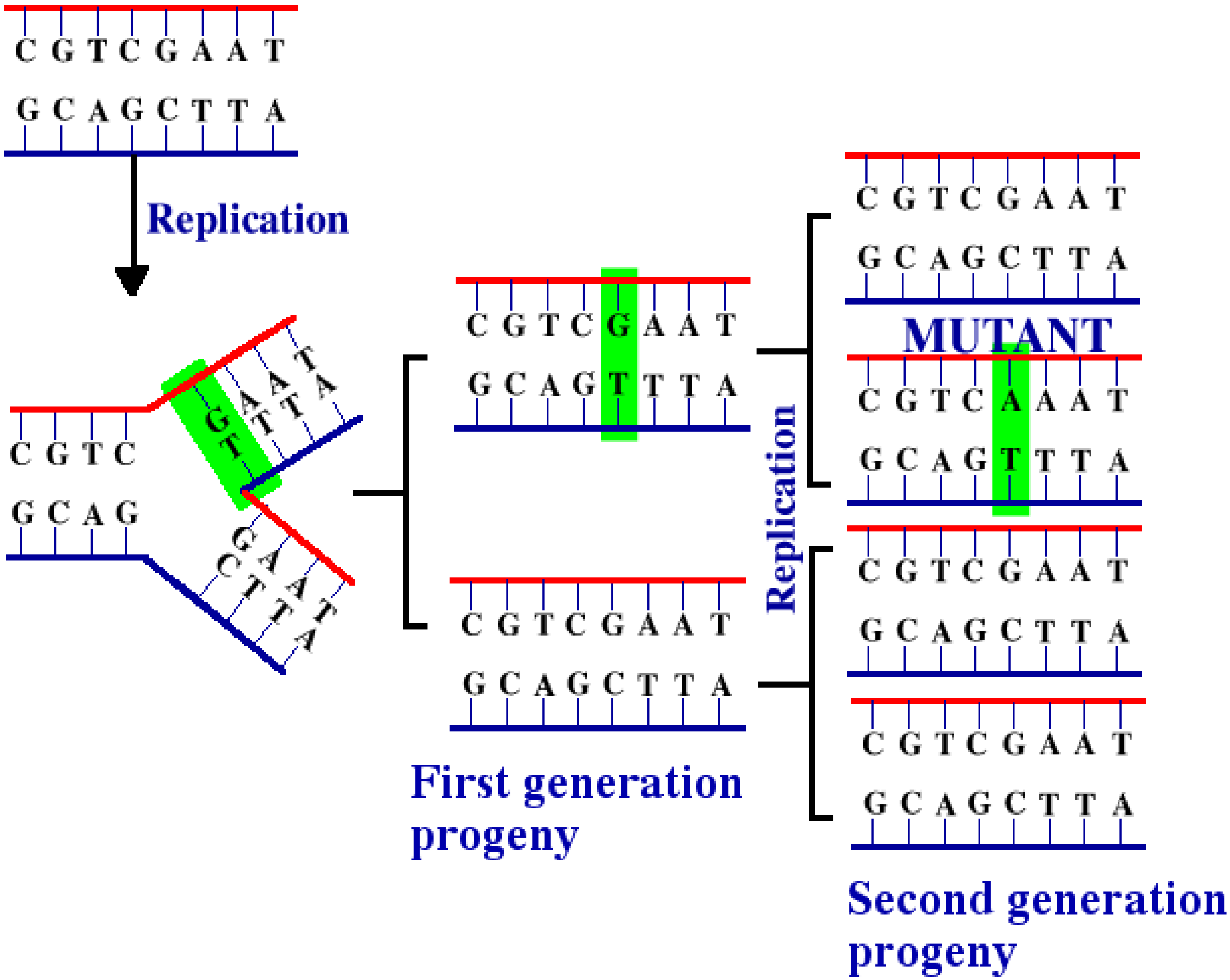
a.) mutation - purine for purine or pyrimidine for pyrimidine substitution (e.g. a rare form of G, called a tautomer, can occur that pairs with T instead of C)

b.) mutation - a purine is substituted for a pyrimidine or a pyrimidine for a purine (less common because of steric problems)

2.) Formation of a stable mutant takes

Guanine Tautomerization




C G T C G A A T
G C A G C T T A
Replication
C G T C G A A T
G C A G T T T A
C G T C G A A T
G C A G C T T A
First generation progeny
Replication
C G T C G A A T
G C A G C T T A
MUTANT
C G T C A A A T
G C A G T T T A
C G T C G A A T
G C A G C T T A
C G T C G A A T
G C A G C T T A
Second generation progeny

3.)

Changes caused by gene mutation:	
Mutation type	**Description**
mutation	
mutation	**Results in the incorporation of a**
mutation	**Results in the incorporation of the**
mutation	**A codon that specifies an amino acid is converted to a**
mutation	
mutation	**The mutation occurs in an and causes death under certain conditions (e.g. high temperature)**

In the base substitution pictured previously, a T was mistakenly incorporated instead of a C. This causes a change in the template strand of DNA such that three dNTPs encoding for one codon in RNA becomes 3'AGT 5' instead of 3'AGC 5'.

a.) Is this a point mutation?

b.) Is this a missense mutation?

b. Removal or addition of nucleotides

1.) The deletion or addition of one or two nucleotides

a .

THEBIGDOGATETHEPIG

THBIGDOGATETHEPIG

a.) All of the codons beyond the frameshift mutation are . They encode for the or may even be . The protein synthesized is and may even be .

b.) If the frameshift occurs on an operon, it may affect all of the .

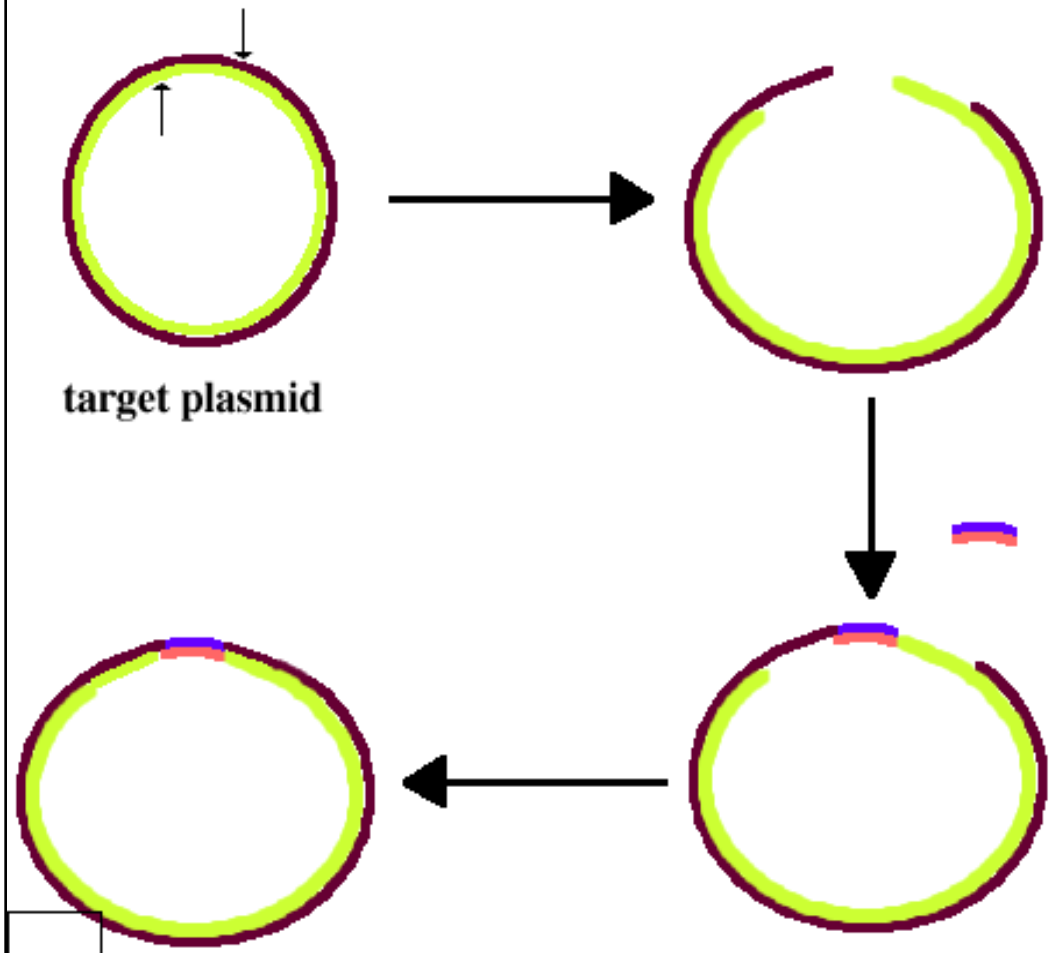
c.) Frameshift mutations are often mutations.

2.) If three nucleotides are added or removed, a protein product is produced that either .

c. (transposons or)

1.) Special DNA segments that

This process is called transposition.



2.) If a transposable element inserts itself into a gene, it can ; it may carry transcription termination sequences, stop codons, promoter sequences or even

2. Types of induced mutation

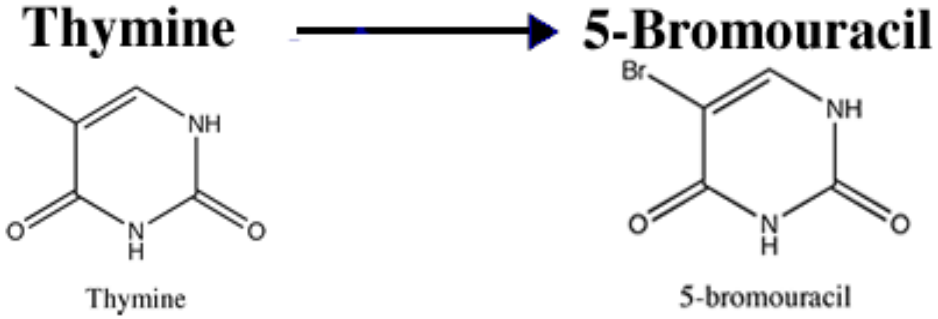
a. - add methyl groups to the bases causing

(e.g. nitrosoguanidine adds methyl groups to guanine

causing it to).

b. - resemble a purine or pyrimidine so closely that they

are .



c. (Ethidium Bromide)- insert between adjacent base pairs in the replication fork. This and often leads to mutation.

B. Mutants

1. Not all mutations are , some provide a and allow for

a.

b. - allows a pathogen to (e.g. *Neisseria gonorrhoeae*).

2. Mutations can be detected

a. when the mutation causes an obvious change in phenotype (colonial or cellular morphology).

b. By - inoculating cells onto a medium on which (e.g. TSA containing streptomycin).

c. By - needed to detect mutants lacking some ability that WT cells have.

Requires the same nutrients as a member of its species.

Can grow on the most that a naturally occuring member of its species could.

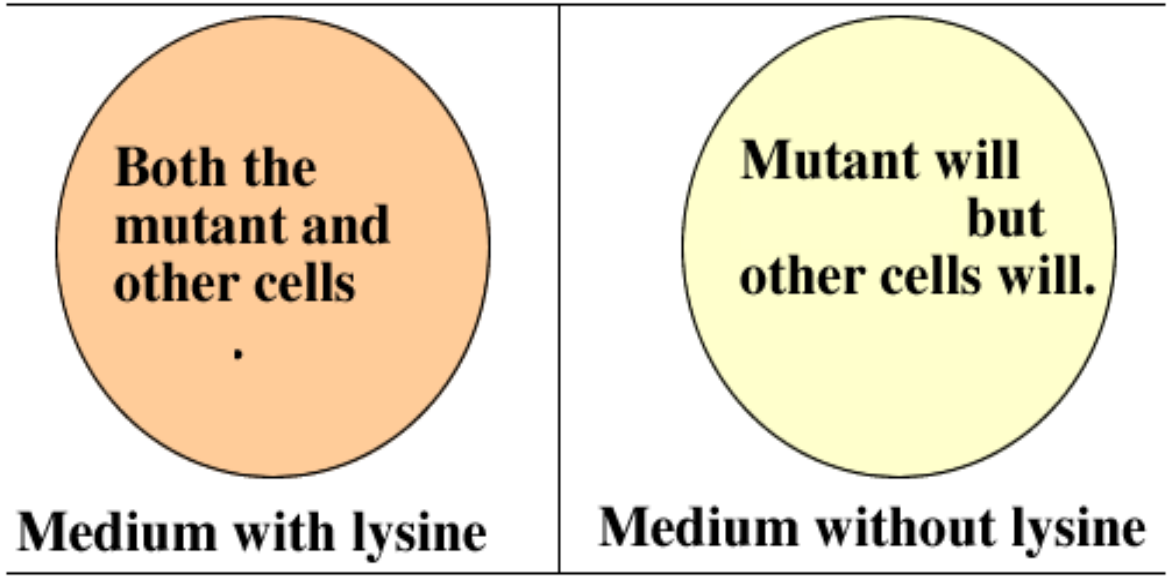
Has all functional biosynthetic pathways for the synthesis of .

A mutant that has to synthesize some growth factor and thus requires that this growth factor be in the culture medium.

Example: An *E. coli* strain has lost its ability to synthesize lysine.

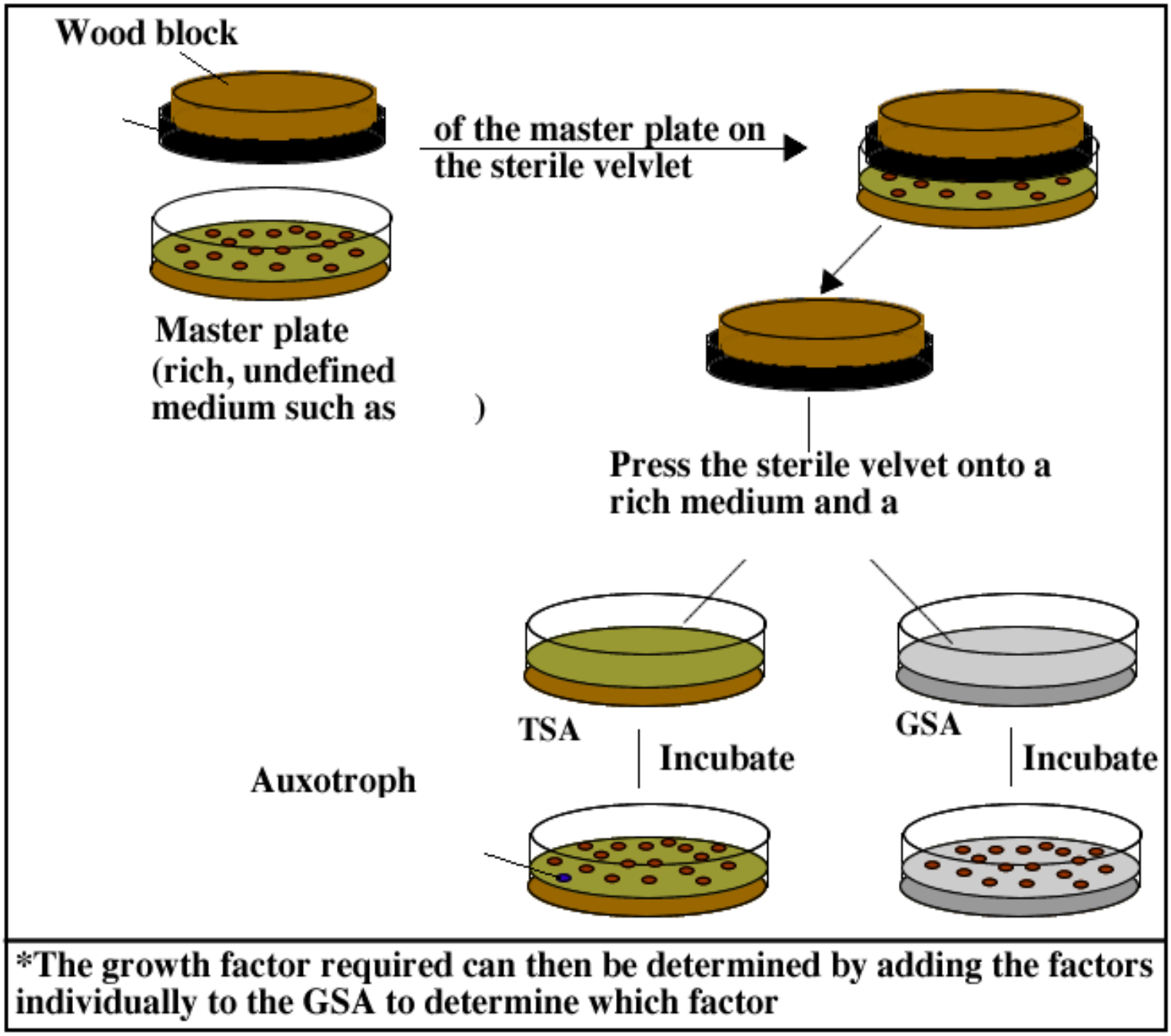
Genotype:

Phenotype:



***There is no way to for the mutant because there is no medium on which**

Replica Plating:

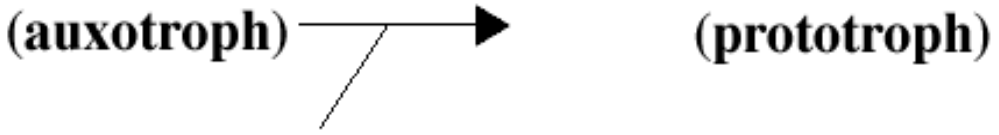


*The growth factor required can then be determined by adding the factors individually to the GSA to determine which factor

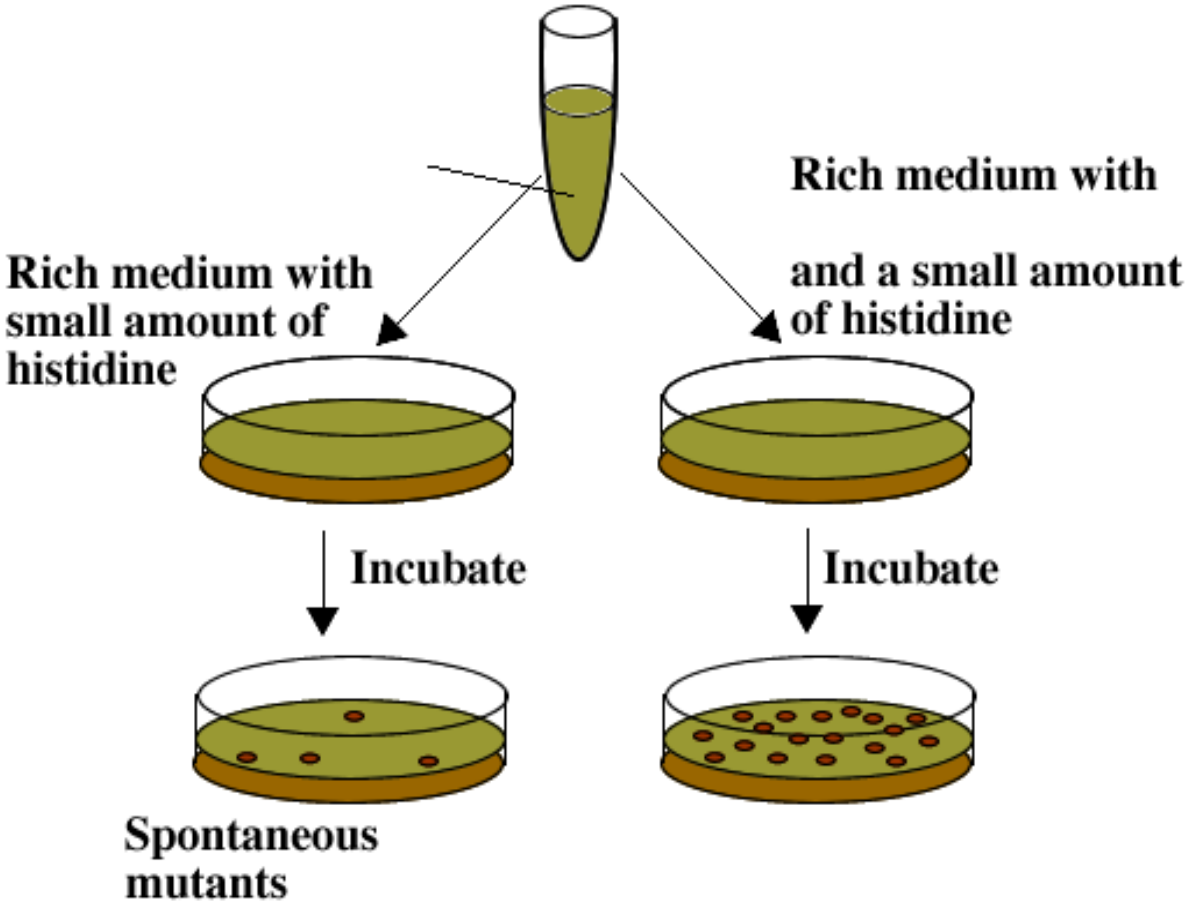
3. Chemicals may be assayed for their carcinogenic nature by testing their effect on DNA in a microbiological system.

a. Identifies environmental based on their ability to act as in a bacterial system.

b. Measures the of a histidine auxotroph of *Salmonella*.



- A indicates that the substance is a mutagen.


Rich medium with small amount of histidine
Rich medium with and a small amount of histidine
Incubate
Incubate
Spontaneous mutants

A bacterium that is Trp-

a. is a prototroph.

b. could be isolated using replica plating.

c. could be isolated using the Ames Test.

d. has a trp+ genotype.

e. could be isolated using direct selection.