Lecture 16: Mutation
I. Genetic diversity in microorganisms - created by

Genotype can be changed in two ways:

- A

in the nucleotide base sequence of DNA.

- occur in the absence of any added

- Result from an added mutagen.
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

\[ \text{Guanine} \leftrightarrow \text{Nucleobase} \]
Replication

First generation progeny

Second generation progeny

MUTANT
3.) **Changes caused by gene mutation:**

<table>
<thead>
<tr>
<th>Mutation type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>mutation</td>
<td>Results in the incorporation of a</td>
</tr>
<tr>
<td>mutation</td>
<td>Results in the incorporation of the</td>
</tr>
<tr>
<td>mutation</td>
<td>A codon that specifies an amino acid is converted to a</td>
</tr>
<tr>
<td>mutation</td>
<td>The mutation occurs in an and causes death under certain conditions (e.g. high temperature)</td>
</tr>
</tbody>
</table>
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

\[
\text{Thymine} \quad \rightarrow \quad 5\text{-Bromouracil}
\]

\[
\text{Thymine} \quad \quad \quad \quad \quad \quad \quad 5\text{-bromouracil}
\]

c. (Ethidium Bromide)- insert between adjacent base pairs in the replication fork. This 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 occurring 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:

| Both the mutant and other cells | Mutant will but other cells will. |
| Medium with lysine               | Medium without lysine              |

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

Wood block

of the master plate on
the sterile velvet

Master plate
(rich, undefined medium such as)

Press the sterile velvet onto a
rich medium and a

Auxotroph

TSA | Incubate

GSA | Incubate

*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*.

\[(\text{auxotroph}) \rightarrow (\text{prototroph})\]

- 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.