Biol 3301: Genetics  
Exam #3  
November 28, 2001

NOTE: A few questions have been removed because they involved material that I didn’t cover this semester.

2. (2) Lysine is encoded by AAA and AAG codons. If an AAG codon were mutated to UAG, the type of mutation would be called
   a) silent        b) missense       c) nonsense     d) transition    e) prototrophic
   answer - c

3. (2) Lysine is encoded by AAA and AAG codons. If an AAG codon were mutated to AAA, the type of mutation would be called
   a) silent        b) missense       c) nonsense     d) transversion  e) prototrophic
   answer - a

4. (2) Lysine is encoded by AAA and AAG codons. If an AAG codon were mutated to AGG, the type of mutation would be called
   a) silent        b) missense       c) nonsense     d) transversion  e) prototrophic
   answer - b

5. (4) The #mutations/unit time measures ___mutation rate__________, whereas the occurrence of a
   mutation in a population measures ___mutation frequency____.

6. (2) Luria and Delbruck used the fluctuation test to show that mutations __pre-exist/are random__ in a population.

7. (4) The rare imino form of cytosine pairs with adenine. If a cytosine within the DNA helix shifts to the imino
   form during replication, base pairing would change from ____CG____ to _____TA____.

8. (2) In E. coli, a protein coding region of a gene with repeats of the sequence GTAA will be prone to
   a) Nonsense mutation    b) Missense mutation   c) Frameshift mutation   answer - c
d) Reversion            e) Silent mutation

9. (8) Indicate the type of mutation that is reverted in the following reversion test.

   **REVERSION MUTAGENS**

<table>
<thead>
<tr>
<th>Mutation</th>
<th>EMS + 5-BU</th>
<th>Acridine orange</th>
<th>Aflatoxin B₂</th>
<th>spontaneous</th>
</tr>
</thead>
<tbody>
<tr>
<td>transition</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>transversion</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>frameshift</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>deletion</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

10. (4) In the newly replicated DNA below, state which mismatched base will be repaired by the mismatch repair system and why, and what the correct base pair should be.

\[
\begin{array}{c}
\text{G} \\
\text{T}
\end{array}
\text{GATC}
\begin{array}{c}
\text{T} \\
\text{CTAG}
\end{array}
\]

The T is mismatched because the template strand is methylated. A C should be added for the T.

12. (2) A chromosomal ___deletion____ can account for the following data: reduces crossover in heterozygotes, lethal as a homozygote and unmasks recessive alleles.

13. (2) Which chromosomal aberration supplies additional genetic material capable of evolving new functions?

A duplication

14. (8) Match the mutation with the appropriate repair mechanism.

| 2_______8-oxo-dG | 1) AP repair |
| 4_______Pyrimidine dimer | 2) the GO system |
| 1_______Apurinic site | 3) alkyltransferases |
| 3_______O-6-ethylguanine | 4) nucleotide excision repair |

15. (4) The two loci Cy and Sco are normally 24mu apart on chromosome 2 of Drosophila. A paracentric inversion spans about one half of the distance between these loci, but not include either of the loci. What approximate recombination frequency would you expect for these loci in (a) flies heterozygous for the inversion and (b) flies homozygous for the inversion.

a) In heterozygotes the recombination frequency will be reduced by 1/2 because there is no crossing over in the region of the inversion, thus the RF will be 12%.

b) In homozygotes the RF will be 24% since both homologs are inverted and can pair throughout during meiosis.

16. (6) For the reciprocal translocation heterozygote shown below, draw how the chromosomes will pair at meiosis I and which products would result from adjacent I segregation.

17. (4) Allopolyploids are generated by making hybrids between ___different____ species.

18. (2) Monosomics and trisomics are due to ___nondisjunction____ during meiosis.

19. (2) The proportion of normal gametes produced by an individual with Down syndrome (trisomy 21) will be
   a) 1/8
   b) none
   c) 1/4
   d) 1/2
   e) 1/3
   answer - d

20. (2) In a haploid cross of m x +, which of the following linear octads shows the occurrence of chromatid conversion?
   a) +++++++mmm
   b) ++m++m++
   c) ++++mmm
   d) mm++++++
   e) mmm+++
   answer - d

21. (2) According to the Holliday model for recombination, which of the following linear ascus ratios is caused by correction of one heteroduplex?
   a) 4:4
   b) 5:3
   c) 3:1:1:3
   d) 6:2
   answer - b

22. (2) Both the Holliday and double strand break-repair models for recombination begin with a double strand break. Which model requires the resolution of two Holliday junctions?
   The double strand-break-repair model requires resolution of two Holliday structures.

23. (2) In corn, transposition of Ds requires the function of an ______Ac_______ element.

24. (2) Which enzyme is used to initiate retrotransposon replication?
   a) DNA polymerase I
   b) DNA polymerase γ
   c) RNA polymerase II
   d) Reverse transcriptase
   e) DNA polymerase α
   answer - d

25. (2) The most prevalent transposable elements in humans are
   a) viral retrotransposons
   b) SINE elements
   c) transposons
   d) LINE elements
   e) insertion sequences
   answer - b

26. (2) In preparation for intergration, a bacterial transposon cuts the chromosome at the sites indicated below. How many bases will be directly repeated at each end once the transposon has integrated?

   5’ GACAGAATTCCAGATAGCTAGCGAGGCACCATT 3’
   3’ CTGTCTTAAAGGTCTATCGATCTAGCCGCTGCGG 5’

   answer - d

   a) 8
   b) 17
   c) 15
   d) 14
   e) 30

27. (5) List five phenomena that will increase genetic variation.

   1) mutation
   2) recombination
   3) migration
   4) small population size
   5) inbreeding
   6) assortative (non-random) mating
   7) natural selection
28. MN blood group genotypes were measured in people from an isolated pacific island with the following results.

<table>
<thead>
<tr>
<th>Genotypes</th>
<th>MM</th>
<th>MN</th>
<th>NN</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observed numbers (n = 100)</td>
<td>30</td>
<td>50</td>
<td>20</td>
</tr>
</tbody>
</table>

(2) What are the genotype frequencies?  
\[ MM = 0.30, \ MN = 0.50, \ NN = 0.20 \]

(2) What are the allele frequencies?  
\[ p = M = 0.30 + (0.5)0.5 = 0.55 \]
\[ q = N = 0.20 + (0.5)0.5 = 0.45 \]

(3) What are the expected genotypic frequencies?  
\[ p^2 = (0.55)^2 = 0.3025 = MM \]
\[ 2pq = 2(0.55)(0.45) = 0.495 = MN \]
\[ q^2 = (0.45)^2 = 0.2025 = NN \]

29. (2) The norm of reaction can best be described as  
\[ a) \text{the affect of environment on phenotype} \]
\[ b) \text{the effect of variable expressivity on phenotype} \]
\[ c) \text{the effect of allele frequency on genotypic frequency} \]
\[ d) \text{the effect of genotypic frequency on phenotype} \]
\[ e) \text{the effect of heritability on phenotype} \]

answer - a

30. (2) Which component of genetic variance predicts how well phenotype is passed from parent to offspring?  
\[ a) \text{V}_I \]
\[ b) \text{V}_A \]
\[ c) \text{V}_D \]
\[ d) \text{V}_M \]
\[ e) \text{V}_E \]

answer - b

31. (2) Which of the following strains of wheat is a generalist and why?

Strain B is a generalist because it produces relatively high yields under both environmental conditions.

32. (2) A regression of offspring on parents is shown below for different traits. Which trait is completely genetically heritable and which one is not at all genetically heritable?

Trait #1 is completely genetically heritable.  
Trait #2 is not at all genetically heritable.