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**Quiz Questions Revisited: These are the questions that were missed most often. At least one of them will be asked again on Exam 3.**

1) Which of the following statements about the three iguana experiments on the evolutionary advantage of fever is false?
   a) non-homeothermic animals like iguanas cannot respond to the pathogen by raising their body temperatures
   b) fever favored the host
   c) iguanas kept at different fixed temperatures survived better in warmer temperatures
   d) it is best not to suppress fevers unless severe
   e) killed bacterial pathogens still produced the same host response

2) Which of these statements is FALSE concerning the evolution of the bombardier beetle, a favorite target of creationists and intelligent design advocates highlighted in study guide 1 (see link to article).
   a) As noted, several of the intermediate stages are known to be viable by the fact that they exist in living populations.
   b) In various insects, different defensive chemicals besides quinones appear. This helps those insects defend against predators that have evolved resistance to quinones. One of the new bombardier defensive chemicals is hydroquinone.
   c) Quinones (chemicals involved in the explosive defense of bombardier beetles), are produced by epidermal cells for tanning the cuticle. This exists commonly in arthropods.
   d) The bombardier beetles' mechanism can come about solely by accumulated microevolution. All of the steps are probably advantageous, so they would be selected. No improbable events are needed.
   e) It is single system composed of several well-matched, interacting parts that contribute to the basic function, wherein the removal during evolution of any one of the parts causes the system to effectively cease functioning; it is irreducibly complex

From the NOVA documentary:
3) The verdict in the Kitzmiller v Dover case rested on whether the defense could prove a scientific basis for Intelligent Design (ID). Which of the following statements about ID or proposed examples of "irreducible complexity" is FALSE:
   a) Intelligent design is based on the observation of a structure that is complex and seemingly perfectly designed.
   b) Intelligent design is based on the perception of a "purposeful arrangement of parts."
   c) Experiments have been performed whose results support Intelligent Design
   d) There are structures that are similar to flagella in structure and protein content but are simpler and illustrate possible early stages in the evolution of the flagellum. The flagellum is therefore evidence <u>against</u> irreducible complexity.
   e) There are other insects that have defenses similar to those of the bombardier beetle and illustrate possible transitional forms in the evolution of explosive defense. The bombardier beetle is therefore evidence <u>against</u> irreducible complexity.

**Most of this study guide was given to you last week, here the questions are divided by lecture, a few more questions are added mostly at the end.**

**Lecture 15.**
**Variation in Natural Populations**

Know Mendel's laws and understand the causes of deviation from Mendelian ratios in individual crosses.

Define polymorphic and give three examples of polymorphic traits in nature.

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Define ecotype. How could ecotypic variation be distinguished from phenotypic plasticity?

What is a "common garden" experiment used for?

$V_{total} = V_{genetic} + V_{environment}$

Can natural selection modify variation due to the environment?

Define "genetic assimilation" and explain how it could be important in evolution.

How does methylation of DNA sequences modify epigenetic inheritance? Where does it act in a DNA sequence (gene body, promoter, transposons. Are there any organisms where methylation has not been found?

What does the Hardy Weinberg equation allow us to predict?

What two important points are made by the Hardy-Weinberg theorem? (Hint: How would a population biologist make use of the equation?)

If a population is perturbed by natural selection or migration and then that perturbation is removed, how long will it take the population to return to equilibrium?

**Lecture 16. Hardy-Weinberg (cont.), Inbreeding, intro to drift.**

What are the assumptions of the Hardy Weinberg equation?

You are a population biologist and you sample two populations, thinking that you are sampling one you calculate the observed and expected Hardy Weinberg genotype proportions and you end up with a heterozygote deficiency. Which of the HW assumptions has been violated as a result of your composite population?

There will definitely be a question on exam 3 derived from these three questions: Why do we care about the Hardy Weinberg equation? What is its importance? What is it used for?

Why do we care about violations of the Hardy-Weinberg assumptions?

Why do we care about genetic variability?

Fill in the blank: Early geneticists working with visible mutants believed that variation in natural populations was (circle one) : common, rare, intermediate between common and rare.

When was protein electrophoresis introduced into population biology and by whom?

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What is allozyme protein electrophoresis and how is it able to detect mutations? What mutations does it miss?

What did Lewontin and Hubby demonstrate? How did their results change earlier views?

If the frequency of the common allele in a population was .7 and there were only two alleles at that locus, what would be the expected proportions of each genotype in the next generation, assuming that the population was in Hardy-Weinberg equilibrium?

Discuss the statement, "without genetic variation, there can be no evolution."

Of all the processes that can disrupt the HW equilibrium, which of them create variation and which of them destroy variation and if they can do both, explain how.

Why does migration sometimes not equal gene flow?

Regarding “Coalescence”:

A. Why does the average degree of relationship of individuals increase with the passage of time?

B. True or False: If we look backward in time, all gene copies in a populations ultimately are descended from a single ancestral gene copy.

C. Know that the average time back to common ancestry (coalescence) of a random pair of gene copies in the population is 2N generations, where N = population size.

Define: inbreeding; genetic drift; inbreeding coefficient, random walk, fixation.

How are inbreeding and genetic drift similar?

How are they different?

Can inbreeding occur and have a strong effect in large populations? Can drift have a strong effect in large populations? Explain both.

What is "inbreeding depression" and what causes it?

Why did theoretical ecologists argue that the genetics of a population might be irrelevant to endangered species in nature?

What did the Glanville Fritillary butterfly study illustrate and what were the consequences in terms of life history costs? Do the results of this study agree with studies of other threatened species living in small populations.

What is purging and why might it be dangerous?

Is inbreeding guaranteed to purge most lethal alleles from a population? What does experimental evidence from a review of botanical studies compiled by Byers and Waller suggest?

Which of the following answers is FALSE

a) Inbreeding can have a strong effect in large populations
b) Both inbreeding and drift can have a strong effect in small populations
c) Drift has little effect in a large population
d) Inbreeding was demonstrated to be effective in purging deleterious alleles in an analytical review of the plant breeding literature
e) Inbreeding rare species to purge deleterious alleles is dangerous.
f) Inbreeding causes heterozygosity to decline because alleles identical by descent are more likely to be united
g) Drift causes heterozyposity to decline simply because one allele becomes rare.

How did Alan Templeton save the Speaks gazelle?

Fill in the blank: In a finite population inbreeding causes the proportion of heterozygotes in the population to decline because _____.

Fill in the blank: In a finite population drift causes the proportion of heterozygotes in the population to decline simply because _____.

**Lecture 17. Drift, Effective Population Size, Gene Flow**

Can random genetic drift result in non-adaptive evolution?

Define effective population size.

Why is the effective population size often much lower than the actual population size?

All of the following are reasons that effective population size can be smaller than the actual population size except one? Which one is not a reason?

a. Some males or females do not participate in breeding.
b. Natural selection occurs (some individuals leave fewer progeny).
c. Overlapping generations exist and can mate with each other.
d. Every individual passes on only one of its two alleles at each locus
e. Fluctuations in population size occur.

You are a conservation biologist who is asked to assess the chances for survival of a wide spread, formerly common, species that exists presently only as a series of small isolated populations. If these populations have been small and isolated for some time, would you expect the level of genetic variability in each population to be high or low? Would you expect the level of genetic variation in the total species to be high or low? If you were told that most of the current habitat of this species must be sacrificed to make way for "progress," what would you recommend as the best strategy to try to preserve the species given your limited budget?

Fill in the following blanks to indicate which statement is true of genetic drift (GD), which is true of inbreeding (IN) and which is true of both (B). Use the letter abbreviations or word in parentheses to shorten your response.

1) _____ The smaller the population, the more likely this is to occur

2) _____ Decreases genetic variability in most circumstances.

3) _____ This could happen in a large population if strong positive assortative mating was happening.

4) _____ Causes heterozygosity to decrease at a locus simply because one allele becomes rare.

5) _____ Causes heterozygosity to decrease at one locus because alleles that are identical by descent are more likely to be present in a single individual.

6) _____ Could have a positive effect on preserving variability if many populations of a single species are small and isolated.

7) _____ Which of the two, genetic drift or inbreeding, is most likely to result in combinations of rare deleterious alleles in homozygotes?

Define: Founder effect.

How many colonists do you need to preserve 75% of the variability in the original source population?

How will a short population bottle neck affect heterozygosity?

How will an extended bottle neck affect heterozygosity?

How will a short bottle neck affect the number of alleles in a population?

Give one example of a population or species that was used as an example of a genetic bottleneck.

Is mutation alone a strong force in evolution?

Diagram each of the following models of gene flow: a) "continent-island", b) "island", c) "stepping-stone", and d) "isolation-by-distance."

True or false: In the absence of strong selection, even a low amount of gene flow greatly reduces the divergence among populations.

True or false: the tendency of genetic drift to augment the total genetic diversity of a species by fixing different alleles in different populations can be counteracted by gene flow.

**Lecture 18. Population Genetic Structure- Ecology, Climate, Gene Flow, Neutral Theory.**

Monarch butterflies and winged versus wingless water strider and stonefly species have been used to demonstrate what?

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Explain how gene flow and selection work together to affect the pattern of banded water snakes in the vicinity of Lake Erie.

) Pocket gophers have strong among-population differences in allozyme frequency. Chromosomal translocations differ among populations and contribute to a lack of gene exchange and suggest speciation in progress. Why is it suspected that something other than natural selection has led to differences among populations in chromosomal translocation type?

How does Godfrey Hewitt explain his many examples of "Northern purity, Southern richness"? In your answer explain what we mean by purity vs richness.

What causes some populations to be highly structured in genetic variation across a landscape? How has the climatic history of the last 2.6 million years (and especially the last 20,000 years) affected organisms and their genetic variation. Can ecological differences among species affect their genetic structure? Explain.

What determines the probability of fixation of an allele if only genetic drift is acting?

Kimura (1968) argued that most variation in natural populations was due to _____ .

Did he argue that adaptive features do not evolve by natural selection?

Define silent substitution? Synonymous substitution? Non-synonymous substitution? Replacement substitution?

How does the secondary and tertiary structure of molecules affect DNA substitutions?

Are all third positions of codons selectively neutral? Explain.

Are all second positions of codons selectively neutral? Explain.