BIO 100 Study Guide **Assignment #33**

Chapter 15 EXPLAINING THE DIVERSITY OF LIFE

OVERVIEW: Comparison of *creation* and *evolution* models with respect to interpretation of several phenomena: fossil record, mutations, limits of biological change, and natural selection.

STRATEGY: This assignment is divided over two days. You are encouraged to use Chapter 15, pages 338-362 as a resource to complete the tasks under LEARNING GOALS. The attached resource pages contain highlights that we will consider in lecture. Having laid the philosophical groundwork in the previous assignment, you should be asking "which model is most consistent with what is observed in the fossil record and in biological phenomena, namely mutations, biological change, and natural selection?"

VOCABULARY:

fossil record	living fossil	macroevolution
Cambrian explosion	punctuated equilibrium	microevolution
transitional form	mutations	artificial selection
		natural selection

LEARNING GOALS:

1. Explain what causes Darwinian evolutionists to hold to a uniformitarian view of the geology; whereas, young-Earth creationists see support for catastrophism.

2. If evolution occurred, what should one expect to find in the fossil record? Discuss two or more predictions of the "evolution model" that have not been supported by the fossil record.

3. All of the sedimentary layers of the "geologic column" have never been found intact from the oldest deposits to the newest anywhere on Earth Instead, the layers are pieced together by inference from oldest (bottom) to the youngest. Describe the reasoning that is used.

4. Discuss two major problems with the suggestion that mutations are the source of new genetic information necessary to account for he more complex forms that are said to have evolved from simpler forms.

5. Use two graphs, each with an origin at the intersection of an x-axis (time) and a y-axis (biodiversity) to explain how Darwinian evolution (macroevolution) differs from microevolution.

6. What are three sources of variation in a gene pool? Explain how microevolution is defined in terms of gene frequency. Is there scientific evidence for microevolution? Give examples.

7. Distinguish *stabilizing selection, directional selection,* and *disruptive selection*; and, illustrate each manifestation of natural selection with one example.

LECTURE EMPHASIS will reflect the emphasis and sequence of the LEARNING GOALS.

FOSSIL RECORD

		EVOLUTION	CREATION
A.	**ORIGINS HYPOTHESIS:**	UNIFORMITARIANISM	CATASTROPHISM
B.	**SIGNIFICANCE OF GEOLOGIC COLUMN**	RESULT OF GRADUAL DEPOSIT OF SEDIMENTS	RESULT OF SHORT-TERM CATACLYSMIC "FLOOD"; PRESERVED ORG. MATTER
C.	**TIME "SCALE"**	MILLIONS OF YEARS	THOUSANDS OF YEARS
D.	**FOSSILS ARE RECORD OF...**	GRADUAL EVOLUTION BY NATURAL SELECTION	A FEW CATASTROPHIC BURIALS
E.	**TRANSITIONAL FORMS:**		
	> PREDICTION:	SHOULD FIND GRADUAL TRANSITIONS FROM SIMPLE --> COMPLEX	SHOULD FIND "GAPS" BETWEEN "KINDS"
	> OBSERVATIONS:	1) "MISSING LINKS" –	
		2) "EXPLOSIONS" –	
		3) "LIVING FOSSILS" --	
		4) MASS EXTINCTIONS --	

MUTATIONS

DEFINITION: CHANGES IN DNA SEQUENCE; EITHER SPONTANEOUS OR LAB-INDUCED

MUTAGENS: UV RADIATION, RADIOISOTOPES, ETC.

NEO-DARWINIAN CLAIM:

> More than two million species of organisms live on earth, descendants of one or only a few primordial forms of life. Without the occurrence of hereditary changes [mutations], life could not have evolved or diversified... T. Dobzhansky
>
> If spontaneous mutations over millions of years have produced the genetic variation (new and different alleles) upon which natural selection has operated to produce evolutionary change and new species, then...

NEO-DARWINIAN PREDICTION: induced mutations in populations under controlled experiments should produce at least some beneficial phenotypic alterations which improve fitness, and thus, are retained in the gene pool.

OBSERVATIONS:

1. MOST MUTATIONS ARE _____
2. MANY MUTANTS SURVIVE ONLY IN _____
3. SECOND LAW OF THERMODYNAMICS -- INCREASING _____
4. PROBLEM: PRESERVING ENOUGH "GOOD MUTATIONS" TO FORM ORGANS

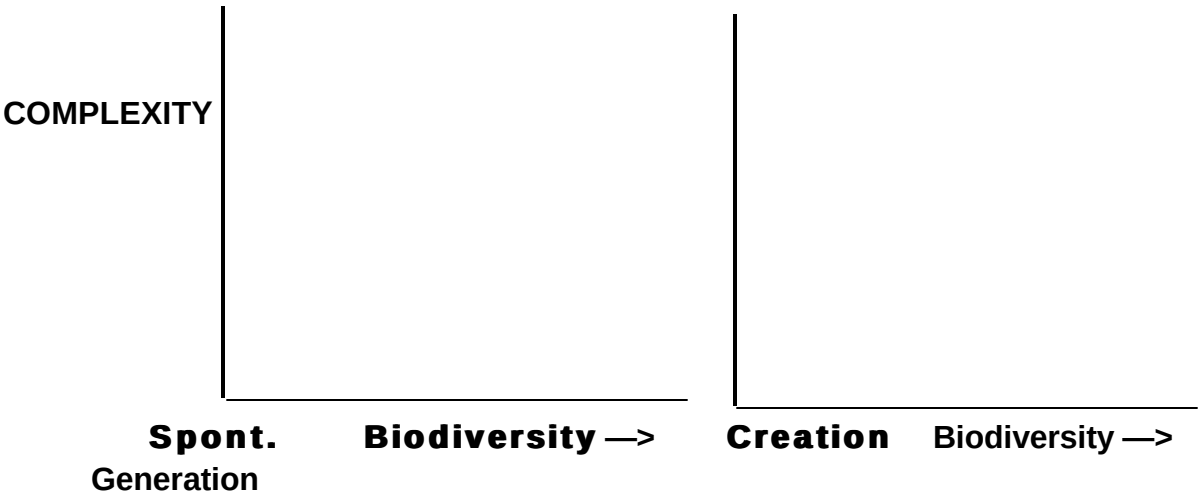
MICHAEL BEHE's CHALLENGE: "IRREDUCIBLE COMPLEXITY"

BIOLOGICAL CHANGE -- ARE THERE LIMITS ?

1. ABSENCE OF TRANSITIONAL FORMS -- Are "kinds" _____?
2. A FEW MASS EXTINCTIONS -- Where is meaningful _____?
3. "EXPLOSIONS" OF NEW BODY PLANS -- Where are _____?
4. "LIVING FOSSILS" -- Is "_____" the predominant mode?
5. MUTATIONS -- Where is evidence of their _____ in nature?

Table 15-3 Two Interpretative Models of Biological Change.

MACROEVOLUTION	MICROEVOLUTION
VARIATION BEYOND "KINDS"	**VARIATION WITHIN "KINDS"**
BROAD, VERTICAL	**NARROW, HORIZONTAL**



PREHISTORICAL	**HISTORICAL**
SUPPOSED	**OBSERVED**
INFERRED	**TESTABLE**

NATURAL SELECTION & POPULATION GENETICS

GENETIC VARIATION (among members)	+	ENVIRONMENTAL RESISTANCE (phenotypes are put to the test)	----> SURVIVAL/REPRODUCTION OF ORGANISMS EXPRESSING SUITABLE PHENOTYPES (*NATURAL SELECTION*)

SOURCES OF GENETIC VARIATION IN A GENE POOL:

1. MUTATION
2. MIGRATION of individuals to/from other gene pools
3. MEIOSIS: Independent assortment and crossing over

CONDITIONS NEEDED TO PREVENT MICROEVOLUTION :

i.e. MAINTAIN HARDY-WEINBERG EQUILIBRIUM

1. No mutations occur at the chromosome *locus* of that allele
2. No immigration or emigration -- *i.e.* isolated population
3. No natural selection - All individuals survive/reproduce
4. Population is large -- **minimizes effect of "chance events" that would hinder random mating throughout, or isolate a small group**

EXAMPLE: Red-eyed *Drosophila* (*RR* or *Rr*) and white-eyed (*rr*) lab mutants
Allele *r* is *X*-linked [T.H. Morgan: hemophilia]

WHAT FACTORS INFLUENCE FREQUENCY OF *r* ?

1. Mutation rate -- increases frequency of *r*
2. Immigration /emigration - *r* alleles enter /leave gene pool
3. Natural selection -- *r*-carrying males less prone to mate
4. Population is small, or barriers prevent random mating

NATURAL SELECTION

UNLIKE ARTIFICIAL SELECTION (SELECTIVE BREEDING), NATURAL SELECTION HAS NO WILLFUL PLAN OR "INTELLIGENT ENGINEER"

RATHER, MERELY OBSERVE NATURAL SELECTION BY OUTCOMES:

1. STABILIZING SELECTION:

SLOWING GENETIC DETERIORATION BY LIMITING FREQUENCY OF DELETERIOUS ALLELES

EXAMPLES:

1. HEMOPHILIA
2. SICKLE-CELL ANEMIA

2. DIRECTIONAL SELECTION:

PRESERVING POPULATIONS BY ALLOWING ADAPTATION TO A CHANGING ENVIRONMENT ["TRACKING"]

EXAMPLES:

1. FAVORING PLANTS WITH GREATER ROOT DEPTH
2. FINCHES ADJUST TO CHANGING RAINFALL – "OSCILLATIONS"
2. INDUSTRIAL MELANISM -- MOTHS

3. DISRUPTIVE SELECTION:

FORMING NEW SPECIES FROM ISOLATED POPULATIONS

EXAMPLES:

1. WHITE-EYED FLIES IN FRUIT CRATE
2. "ALBERT" AND "KAIBAB" SQUIRRELS