Slide 1

Explaining the Diversity of Life

BIO 100 Principles of Biology

Cedarville University

Slide 2

WHAT IS A CREATIONIST?

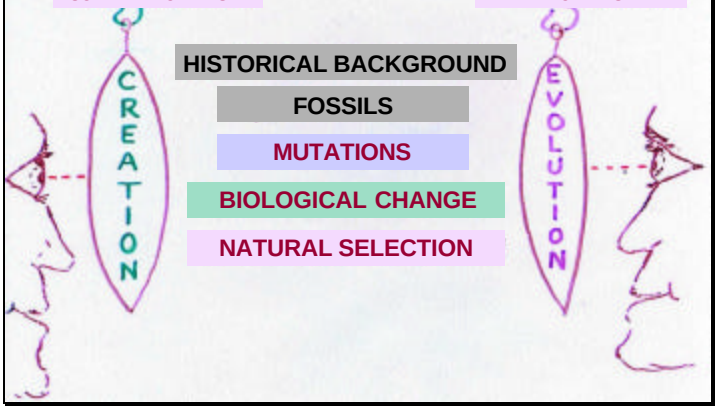
Natural Selection And Death before Adam and the Fall?	Trouble trying to harmonize Genesis and geology?	But be careful in applying science to Genesis.
THEISTIC EVOLUTIONIST	PROGRESSIVE CREATIONIST	YOUNG EARTH CREATIONIST

Slide 3

Origins Hypotheses

FAITH PRESUPPOSITIONS

SUPERNATURALISM	NATURALISM



HISTORICAL BACKGROUND

FOSSILS

MUTATIONS

BIOLOGICAL CHANGE

NATURAL SELECTION

Slide 4

MUTATIONS – SOURCE OF VARIATION?

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

MUTAGENS: UV RADIATION, RADIOISOTOPES, ETC.

NEO-DARWINIAN CLAIM – by T. Dobzhansky

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...

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.

Slide 5

MUTATIONS – SOURCE OF VARIATION?

OBSERVATIONS:

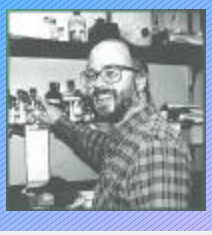
1. **MOST MUTATIONS ARE DELETERIOUS or LETHAL**
2. **MANY MUTANTS SURVIVE ONLY IN THE LABORATORY**
3. **SECOND LAW OF THERMODYNAMICS -- INCREASING DISORDER**
4. **PROBLEM: PRESERVING "GOOD MUTATIONS" TO FORM ORGANS**

MICHAEL BEHE's CHALLENGE: **"IRREDUCIBLE COMPLEXITY"**

Slide 6

Irreducible Complexity

Michael Behe's Definition:



"A single system composed of several well matched interacting parts that contribute to the basic function, wherein the removal of any one of the parts causes the system to effectively cease functioning."

For example:
How many different proteins (hence genes) needed in the bacterial flagellar "motor?"

See Text, Figure 16-14
(cannot publish here)

Slide 7

Irreducible Complexity

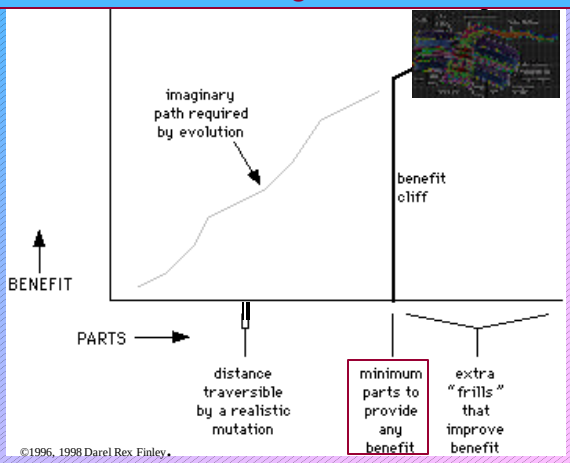
Darwin's Test:

"If it could be demonstrated that any complex organ existed which could not possibly have been formed by numerous successive, slight modifications, my theory would absolutely break down."

-- *Origin of Species*, 1872

Slide 8

Mutations - Can Enough Be Accumulated ?



Slide 9

Irreducible Complexity

Michael Behe's Analysis:

"To Darwin, the cell was a "black box"-- its inner workings were utterly mysterious to him."

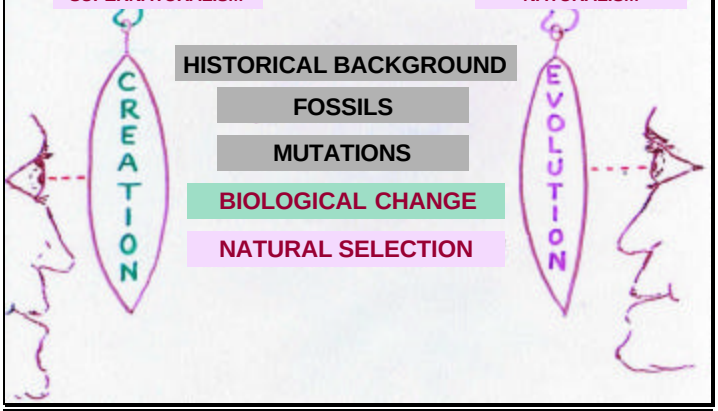
"Applying Darwin's test to the ultra-complex world of molecular machinery and cellular systems…we can say that Darwin's theory has absolutely broken down." *Darwin's Black Box*, 1996

Slide 10

Origins Hypotheses

FAITH PRESUPPOSITIONS

SUPERNATURALISM — NATURALISM



HISTORICAL BACKGROUND

FOSSILS

MUTATIONS

BIOLOGICAL CHANGE

NATURAL SELECTION

Slide 11

Biological Change -- Are there Limits?

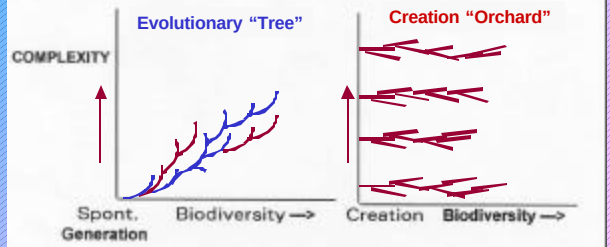
1. ABSENCE OF TRANSITIONAL FORMS -- Are "kinds" distinct?
2. A FEW MASS EXTINCTIONS -- Where is meaningful selection?
3. "EXPLOSIONS" OF NEW BODY PLANS -- Where are ancestors?
4. "LIVING FOSSILS -- Is "stasis" the predominant mode?
5. "MUTATIONS" -- Where is evidence of their benefit in nature?

Conclusion:
There appear to be limits to biological change

Slide 12

Table 15-3 Two Interpretative Models of Biological Change.

MACROEVOLUTION	MICROEVOLUTION (Creationists Accept)
VARIATION BEYOND "KINDS"	VARIATION WITHIN "KINDS"
BROAD, VERTICAL	NARROW, HORIZONTAL



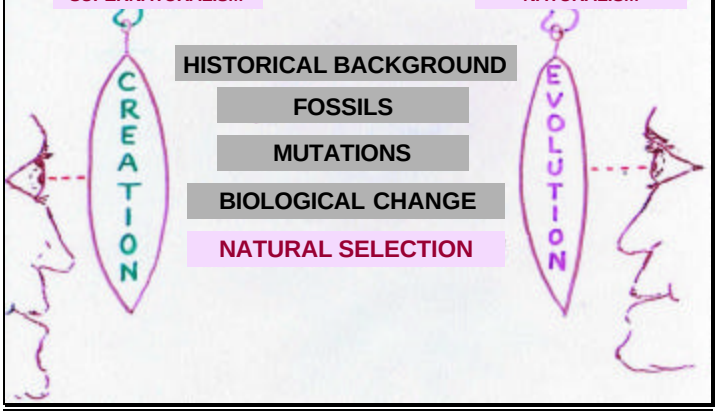
PREHISTORICAL	HISTORICAL
SUPPOSED	OBSERVED
INFERRED	TESTABLE

Slide 13

Origins Hypotheses

FAITH PRESUPPOSITIONS

SUPERNATURALISM — NATURALISM



HISTORICAL BACKGROUND

FOSSILS

MUTATIONS

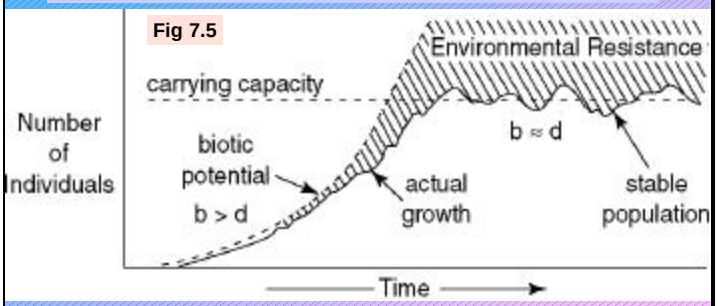
BIOLOGICAL CHANGE

NATURAL SELECTION

Slide 14

Natural Selection

Fig 7.5



GENETIC VARIATION (among members) + ENVIRONMENTAL RESISTANCE (phenotypes tested) ---> SURVIVAL/REPRODUCTION OF ORGANISMS EXPRESSING SUITABLE PHENOTPYES

Slide 15

Natural Selection

GENETIC VARIATION (among members) + ENVIRONMENTAL RESISTANCE (phenotypes tested) → SURVIVAL/REPRODUCTION OF ORGANISMS EXPRESSING SUITABLE PHENOTPYES

SOURCES OF GENETIC VARIATION IN A GENE POOL:

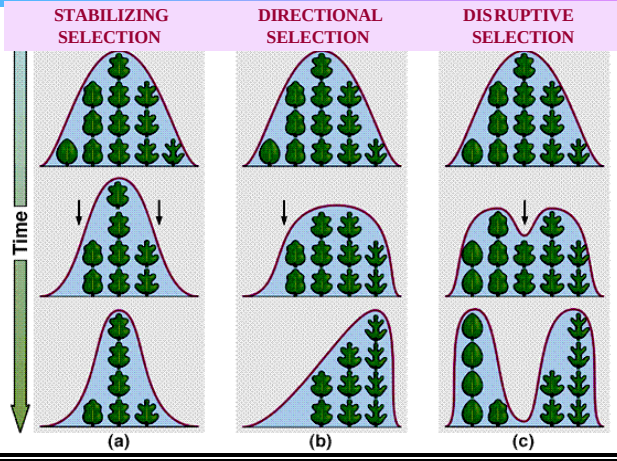
1. MUTATION -- e.g. change in flower color, eye color
2. MIGRATION of individuals to / from other gene pools
3. MEIOSIS -- independent assortment and crossing over

CONDITIONS NEEDED TO PREVENT MICROEVOLUTION:

1. NO MUTATION -- e.g. change in flower color, eye color
2. NO MIGRATION of individuals to / from other gene pools
3. NO NATURAL SELECTION -- all individuals survive/reproduce
4. LARGE POPULATION -- minimizes impact of any of the above

Slide 16

Natural Selection -- Outcomes



Slide 17

Natural Selection -- Outcomes

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

Slide 18

Natural Selection -- Outcomes

SYMPTOM: RED BLOOD CELLS RUPTURE

CAUSE: IMPROPERLY SYNTHESIZED HEMOGLOBIN

GENOTYPE: $Hb^S Hb^S$ (LETHAL RECESSIVE ALLELE)

GEOGRAPHY: MEDITERRANEAN & AFRICA WHERE MALARIA (ANOTHER BLOOD DISEASE) ALSO THREATENS LIVES.

Slide 19

Natural Selection -- Outcomes

QUESTION: WHY DOESN'T NATURAL SELECTION ELIMINATE THE LETHAL Hb^S ALLELE?

> TABLE 15-4

GENOTYPE	SICKLE CELL	MALARIA
$Hb^A Hb^A$	NORMAL	SUSCEPTIBLE
$Hb^A Hb^S$	ANEMIC	HIGHLY RESISTANT
$Hb^S Hb^S$	DEATH	DEATH (by S-C Anem.)

CONCLUSION: Sickle Cell Anemia allele improves fitness against malaria.

Slide 20

Natural Selection -- Outcomes

Table 15-5 Frequency of the Heterozygous Condition for Sickle-Cell Anemia among Geographic Populations of Humans.

GEOGRAPHIC POPULATION	FREQ. OF $Hb^A Hb^S$
African Blacks	25% to 30%
American Blacks	8%
American Whites	<1%

Slide 21

Natural Selection -- Outcomes

2. DIRECTIONAL SELECTION:

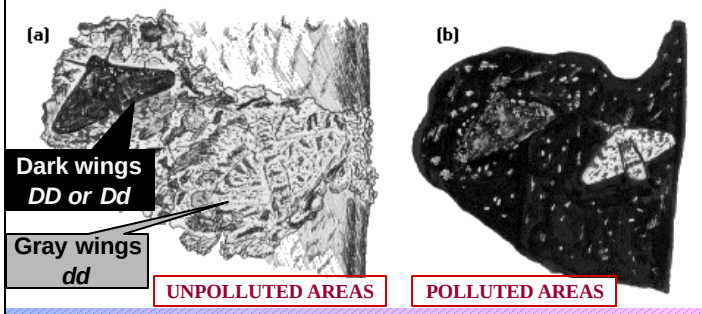
PRESERVING POPULATIONS BY ALLOWING ADAPTATION TO A CHANGING ENVIRONMENT ["TRACKING"]

EXAMPLES:

1. FAVORING PLANTS WITH GREATER ROOT DEPTH
2. INDUSTRIAL MELANISM -- MOTHS

Slide 22

PEPPERED MOTH -- *Biston betularia*
Kettlewell's Experiment in Natural Selection



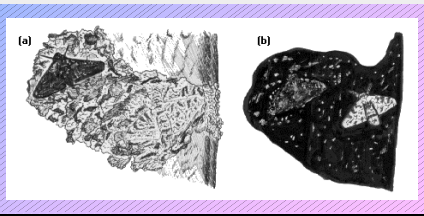
HYPOTHESIS: Predation upon *Biston betularia* depends upon wing color, and natural selection favors the allele (and color) which provides camouflage.

Slide 23

PEPPERED MOTH -- *Biston betularia*
Kettlewell's Experiment in Natural Selection

DEDUCTION: If wing color affects predation, then more moths with favorable camouflage should be recovered as survivors after a period of predation.

EXPERIMENT: Capture and mark a known number of moths of each phenotype. Release the 2 phenotypes into industrial and countryside environments. Estimate percent recovered.



Slide 24

Natural Selection -- PEPPERED MOTH

Table 15-6 Bird Predation and Wing Color in *Biston betularia*.

EXPERIMENTAL CONSIDERATIONS:

1. Experimental sites – choose similar forests except for pollution
2. Moth placement – should reflect day-time resting behavior
3. Time of experiments – conduct as simultaneously as possible
4. Data analysis / interpretation – avoid bias / philosophical
5. Repeatability – experiments should be repeatable by other investigators

Slide 25

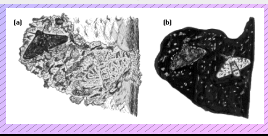
Natural Selection -- PEPPERED MOTH

RESULTS*:

	Number Released		Number Recaptured	
Forest Location	Gray	Dark	Gray	Dark
Polluted	137	493	18 (13.1%)	131 (27%)
Pollution-free	496	488	62 (12.5%)	34 (6.9%)

*Data from Kettlewell (1959) *Scientific American.*
Combined data from Birmingham (1953) and Dorset (1955)

CONCLUSION: Natural selection affects gene frequency in moth populations through selective predation according to wing color.



_You're your text for details of how this experiment and the reporting of the data are in violation of "good science" and the criteria listed on Slide #24.

Slide 26

Natural Selection – Darwin's Finches
Evidence for Evolution?

A research group led by Peter and Rosemary Grant of Princeton University has shown that a single year of drought can drive evolutionary changes in the finches.

Drought diminishes supplies of easily cracked nuts but permits the survival of plants that produce larger, tougher nuts.

Droughts thus favor birds with strong, wide beaks that can break these tougher seeds, producing populations of birds with these traits.

The Grant's have estimated that if droughts occur about once every 10 years on the islands, a new species of finch might arise in only about 200 years.
Science and Creationism: A View from the National Academy of Sciences (50)

____This is the interpretation of the National Academy of Sciences but note how the Grant's interpretation of the data differs as reported in the next slide.

Slide 27

Natural Selection – Darwin's Finches
Microevolution but not Macroevolution

What the Grant's Actually Concluded:

[Directional selection]...has the potential of producing a directional evolutionary change in the population because beak and body size traits are highly heritable. However, the change in mean bill length that occurred as a result of selection in the early phase of the drought was counteracted later in the drought by selection in the opposite direction on bill length, which is positively correlated with bill length. The overall result was no net change between the end of the breeding in 1983 and the resumption of breeding in 1986. [See Chapter 15 for details.]

Detailed analysis published by Rosemary and Peter Grant (1989, p 282):

Slide 28

Natural Selection -- Outcomes

3. **DISRUPTIVE SELECTION:**

FORMING NEW SPECIES FROM ISOLATED POPULATIONS

EXAMPLES:

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

Slide 29

Natural Selection -- Outcomes

Disruptive Selection explains diversity among Humans