

MISCONCEPTIONS ABOUT NATURAL SELECTION

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Bacteria In Ancient Andean Mummies Had Genes For Antibiotic Resistance

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photo credit: The Lulluillaco mummy is often considered the best preserved Andean mummy discovered. Pedro Groover/Flickr CC BY 2.0



The Andes' distinctive mix of both an incredibly dry and yet bitterly cold environment, in combination with the highly ritualized burials of the ancient peoples who lived there around a thousand years ago provides the perfect environment for natural mummification. This gives archaeologists a uniquely detailed insight into the lives of these people, from the opulent clothes they wore, to the hearty meals they ate just before death.

<http://www.iflscience.com/health-and-medicine/bacteria-ancient-andean-mummies-had-genes-antibiotic-resistance>

Observed: $\frac{AA}{0.15} \quad \frac{Aa}{0.65} \quad \frac{aa}{0.20}$

Q1. What are the *expected* genotype frequencies, under the null hypothesis of no evolution and random mating?

	<u>fr(AA)</u>	<u>fr(Aa)</u>	<u>fr(aa)</u>
1.	0.286	0.497	0.216
2.	0.276	0.497	0.266
3.	0.226	0.497	0.276
4.	0.300	0.330	0.370

Q2. Compare the observed and expected values.
Do the data support the null hypothesis?

1. Yes—they are virtually identical
2. No—too many heterozygotes observed
3. No—too few homozygotes observed
4. No—too few heterozygotes observed

I. Constraints on evolution by natural selection

II. Common misunderstandings



Natural selection does not grant organisms what they "need".

Q3. In most human populations, average IQ and average height have increased significantly over the past 100 years. Which of the following is most likely to be correct?

1. The changes in IQ caused the changes in height.
2. The changes in height caused the changes in IQ.
3. Both changes were due to gene x environment interactions.
4. Both changes were due to changes in allele frequencies.
5. There is not enough information to understand what caused the changes.

Why doesn't natural selection produce “perfect” adaptations?

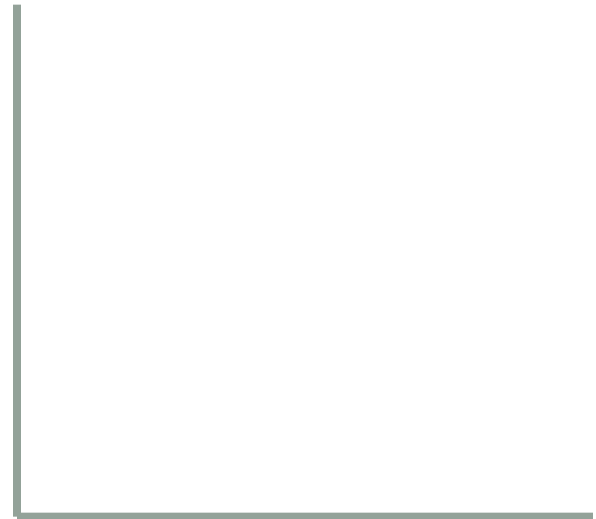
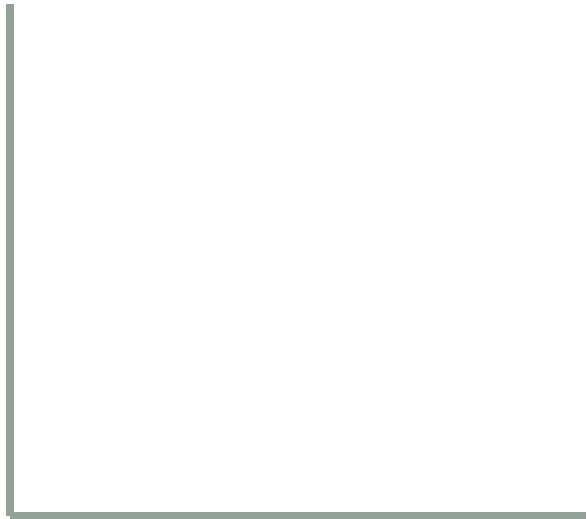
A. Fitness trade-offs—why an “inevitable compromise”?

1. Limited resources ... consider:

- egg/seed size and number
- immune system function vs. physical activity

Q4. When populations of *D. melanogaster* are maintained under constant conditions in the lab and selected for shorter or longer lifespan, dramatic changes in average lifespan are observed. What can you conclude from these experiments?

1. When lifespan changes, average fitness decreases.
2. Lifespan is a trait with heritable variation.
3. Lifespan is driven by gene x environment interactions.
4. Lifespan is driven by gene x gene interactions.
5. Lifespan is a polygenic trait.



Why doesn't natural selection produce “perfect” adaptations?

A. Fitness trade-offs—why an “inevitable compromise”?

1. Limited resources ... consider:

- What is the survival vs. reproduction trade-off?
- What type of environment favors long lifespan and slow reproduction?

Why doesn't natural selection produce “perfect” adaptations?

A. Fitness trade-offs—why an “inevitable compromise”?

2. “Design constraints” (e.g. why can't Boeing make a plane that is fast, maneuverable, fuel efficient, and capable of carrying heavy loads?)

Why doesn't natural selection produce “perfect” adaptations?

A. Fitness trade-offs—why an “inevitable compromise”?

3. “Countervailing selection”

- Primate brain size
- Human height
- Brightly colored feathers in western tanagers

Q5. Big-leaf maples (*Acer macrophyllum*) are tall and have some of the largest leaves found in trees from northern latitudes. Presumably, the large leaf area is advantageous. Why aren't the leaves even bigger?

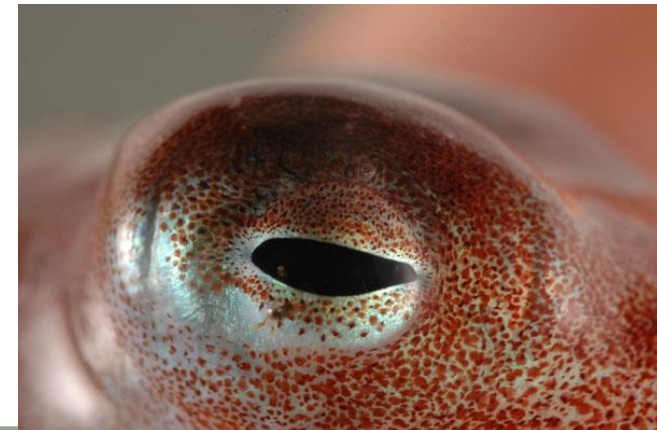
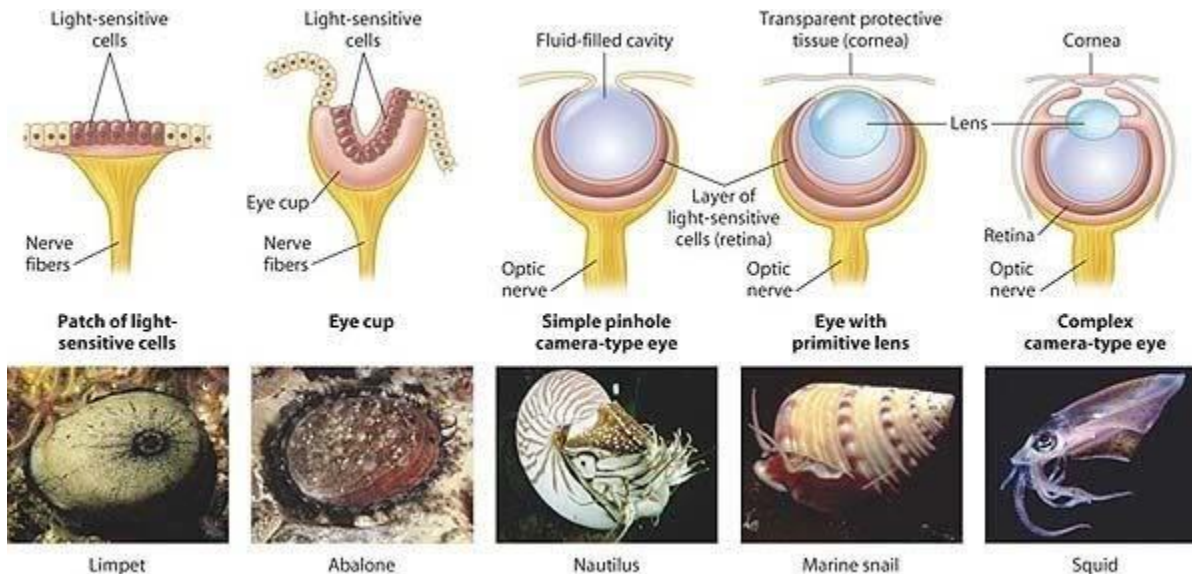
1. Increased mechanical damage or water loss.
2. Photosynthesis wouldn't occur efficiently.
3. Increased damage from large mammalian herbivores such as deer and elk.
4. Time constraints (not enough time has passed for more evolution to occur).

Why doesn't natural selection produce "perfect" adaptations?

B. Historical constraints

1. Selection acts on pre-existing traits, e.g.:

- Cephalopod eyes



Find your blind spot! Using the diagram below, fixate on the cross, close your right eye and hold the figure about 1.5 feet from your face. When the filled circle disappears, its image is on your blind spot. Fixate on the lower cross. Note how the line appears continuous.



Why doesn't natural selection produce “perfect” adaptations?

B. Historical constraints

1. Selection acts on pre-existing traits, e.g.:

- Cephalopod eyes
- Mammalian middle ear
- Human spine and knees

Why doesn't natural selection produce "perfect" adaptations?

B. Historical constraints

1. Selection acts on pre-existing traits, e.g.:

- **“Ghost of selection past”**: e.g. **Why do humans love sugar, fat, and salt so much?**

II. Common misunderstandings

- Evolution is progressive—species get larger, more complex, and better over time
- The strongest or most socially dominant individuals in a population have the highest fitness
- Species anticipate changed conditions and adapt to them; (evolution is forward-looking)

- Evolution is random

- Beneficial mutations happen when they are needed (when the environment changes). For example, Ebola virus will undergo mutations to make airborne transmission possible.

II. Common misunderstandings

- **Individuals sacrifice themselves and help others for the good of the species.**



Q4. What is wrong with the following statement:
“Species adapt to changed environments because they need to in order to survive.”

1. It's not about survival. It's about reproduction.
2. Species don't adapt—individuals do.
3. Frequently, adaptation doesn't occur (species go extinct).
4. There is no need involved—adaptation just happens.