BIOL 4230 — Practice Final — Conceptual-heavy · Variation D

30 MC (3 pts each) + 4 short answer · ~50 min · weighted toward species · phylogeny · sexual selection

Cumulative practice final for BIOL 4230 (Evolution). Mark your answers to all multiple-choice questions on a separate sheet (this is **practice variation Final-D**). Time yourself ~50 minutes closed-note. The answer key and sample short-answer responses are on the last pages.

Multiple choice: 3 points each

1. Two populations of guppies live in adjacent pools. Pool A has heavy predator presence; Pool B has no predators. What life-history difference would you predict?

A) Pool A guppies have longer lifespans because they're tougher.
B) Pool A guppies mature LATER and produce FEWER offspring.
C) Pool A guppies mature EARLIER and produce MORE offspring.
D) No difference — life history is genetically fixed.

2. Two related lizard species occur on different sides of a mountain range that uplifted ~10 MYA. The lizards' lineage split also dates to ~10 MYA. This pattern most likely reflects:

A) Convergent evolution — convergent evolution doesn't speak to phylogenetic split
B) Dispersal — the lizards crossed the mountain after it formed.
C) Drift in a small population — drift doesn't produce a coordinated split timed
D) Vicariance — the rising mountain split a previously continuous population.

3. Which hominin species was the FIRST to disperse out of Africa?

A) Australopithecus afarensis
B) Homo erectus
C) Homo sapiens
D) Homo neanderthalensis

4. Aphids develop into winged or wingless morphs depending on local population density. This is a classic example of:

A) Inheritance of acquired characteristics.
B) Independent assortment of alleles at multiple loci.
C) G×E interaction with no plasticity.
D) A polyphenic trait

5. Antibiotic resistance in bacteria is a textbook example of natural selection because:

A) Resistance is acquired during a bacterium's lifetime and passed via cell division.
B) Antibiotics induce mutations toward resistance.
C) Resistance mutations occur randomly
D) Bacteria deliberately evolve resistance.

6. Sympatric speciation is most common in plants because of which mechanism?

A) Plants have shorter generation times.
B) Polyploidy — whole-genome duplication can immediately produce a reproductively isolated lineage in a single generation.
C) Plants have higher mutation rates than animals.
D) Plants are more mobile than animals.

7. Mayr's Biological Species Concept (BSC) defines a species as:

A) A group of actually or potentially interbreeding natural populations
B) Any group of organisms occupying the same niche.
C) A group of organisms with the same morphology.
D) The smallest monophyletic group identifiable by shared derived characters.

8. Researchers measure trait values, mark individuals, and follow them across years. They observe that birds with longer wings have higher survival. Which additional measurement is needed to predict an EVOLUTIONARY response?

A) Latitude of the population.
B) Heritability of wing length.
C) Total population size.
D) Mating system — mating system can

9. Biogeography is best defined as the study of:

A) The distribution of species and ecosystems in geographic space and through geological time.
B) Genetic differences within a single population.
C) How organisms differ chemically.
D) Climate change effects on individual organisms.

10. Type 2 diabetes is rare in traditional hunter-gatherer populations and prevalent in industrialized populations. Which evolutionary explanation best fits?

A) Mismatch — traits adaptive in ancestral environments (efficient fat storage
B) Industrialized populations have weaker immune systems.
C) Hunter-gatherers have higher mutation rates that prevent diabetes.
D) Hunter-gatherers do not have the genes for diabetes.

11. Muller's ratchet describes:

A) Loss of beneficial alleles by drift in small sexual populations.
B) The clicking sound of bacterial flagella.
C) A directional ratchet of beneficial mutations in sexual populations.
D) Irreversible accumulation of deleterious mutations in asexual populations

12. Rough-skinned newts (Taricha) produce tetrodotoxin (TTX); garter snakes (Thamnophis) eat them. In some regions, snakes are highly TTX-resistant; in others, they have little resistance. What does this geographic variation suggest?

A) There is a coevolutionary geographic mosaic: 'hotspots' of intense reciprocal selection alternate with 'coldspots' of weak interaction.
B) Snake populations migrate between regions, equalizing resistance over time.
C) TTX evolved before snakes evolved resistance, and resistance is still spreading.
D) Coevolution is not actually occurring — the trait is just genetically variable.

13. What does the principle of faunal succession state?

A) Distinct fossil assemblages occur in a consistent vertical order in rock strata
B) Species can be ordered into a fixed hierarchy from simple to complex.
C) Each species evolves directly into the next; lineage is a straight line.
D) Species succeed each other in geographic space, with newer ones replacing older ones in the same habitat.

14. Why is naïve group selection — the idea that traits evolve 'for the good of the species' — generally rejected in modern evolutionary biology?

A) Group benefits are physically impossible.
B) Species don't actually exist as discrete entities.
C) A 'cheater' that exploits cooperation has higher individual fitness than cooperators
D) Group selection only works when the cosmos approves.

15. Why does the common cold (respiratory, directly transmitted) tend to evolve toward MILDER virulence, while cholera (waterborne) does not face the same pressure?

A) The common cold has higher mutation rates.
B) Cholera bacteria are larger than cold viruses.
C) Directly transmitted pathogens need a healthy, mobile host to spread
D) The common cold evolved earlier than cholera.

16. All three of the following must be present for natural selection to produce evolution. Which is NOT required?

A) Differential survival or reproduction associated with the trait.
B) The trait must be heritable — required
C) Variation in a trait among individuals in the population.
D) The trait must benefit the species as a whole.

17. A microRNA binds to a complementary sequence in an mRNA and triggers its degradation. This is an example of:

A) Pre-transcriptional regulation
B) Post-transcriptional regulation
C) Post-translational regulation
D) Transcriptional regulation

18. When biologists say mutations are 'random,' they specifically mean:

A) Mutations only occur during environmental stress.
B) Mutations are unpredictable and cannot be studied scientifically.
C) Mutations occur at every base of the genome with equal probability.
D) Mutations are not directed toward producing adaptations that the organism needs.

19. Fisheries with minimum-size limits (only large fish kept, small ones returned) have led to evolution toward earlier maturation and smaller maximum size in many fish populations. Why?

A) Fish randomly become smaller over time.
B) Smaller fish have higher mutation rates.
C) Younger fish have lower nutritional needs.
D) Selection imposed by humans removes large individuals before they reproduce

20. The largest mass extinction in Earth's history occurred at the:

A) Cambrian explosion, ~541 MYA — the Cambrian explosion is
B) End of the Cretaceous, killing all dinosaurs.
C) K-T (K-Pg) boundary, ~66 MYA, due to asteroid impact.
D) End of the Permian, ~252 MYA, eliminating ~95% of marine species.

21. Which naturalist independently conceived natural selection and, by sending Darwin a letter outlining the idea in 1858, prompted Darwin to publish his work?

A) Thomas Malthus
B) Charles Lyell
C) Alfred Russel Wallace
D) Gregor Mendel

22. Which condition most strongly favors adaptive radiation?

A) Genetic drift in a single population.
B) Open ecological space (e.g.
C) High predation pressure.
D) A stable, fully occupied ecosystem.

23. You're trying to define a clade containing only mammals. 'Has a vertebral column' is a shared trait among all your candidate species. What is this character at the level of mammals?

A) Diagnostic of all mammals but not informative for non-mammalian relatives.
B) A synapomorphy uniting mammals — it's not novel to mammals
C) A symplesiomorphy — present in the deeper ancestor of all vertebrates
D) A homoplasy — independently evolved in different mammalian lineages.

24. Many bird species are now breeding earlier in spring than they did 50 years ago. This represents:

A) Hybridization between bird species.
B) A phenological shift
C) A purely behavioral choice with no evolutionary basis.
D) A speciation event — earlier breeding within

25. What is the 'twofold cost of sex' (Maynard Smith)?

A) Sexual reproduction produces twice as much genetic variation as asexual.
B) Sexual species have twice the mutation rate of asexual species.
C) A sexual female passes on only half as many of her genes per offspring (compared to an asexual female who would transmit all her genes).
D) Sexual reproduction takes twice as long as asexual reproduction.

26. Whose work using fossils and stratigraphy helped establish extinction as a real phenomenon?

A) William Smith
B) Charles Darwin
C) Alfred Russel Wallace
D) Jean-Baptiste Lamarck

27. MHC genes show extreme polymorphism — some loci have >100 alleles in human populations. The most likely cause is:

A) Gene conversion homogenizing the locus.
B) Negative frequency-dependent (balancing) selection from coevolving pathogens
C) Random mutation alone, with no selection.
D) Genetic drift in large populations.

28. Critics sometimes object that 'half an eye is useless,' arguing complex traits like eyes can't evolve gradually. What is the strongest evolutionary response?

A) Eyes evolved in a single dramatic mutation.
B) The objection is correct, and eye evolution is genuinely mysterious.
C) Eyes only evolved once in evolutionary history.
D) Each intermediate stage (light-sensitive patch

29. A hybrid zone exists where two species' ranges overlap and they interbreed, producing low-fitness hybrids. Does the existence of this hybrid zone disprove the species' status under the BSC?

A) Cannot be determined without additional evidence.
B) Yes — only completely non-interbreeding populations are species.
C) No — if hybrids have reduced fitness, gene flow remains limited
D) Yes — any interbreeding means they are the same species.

30. The Silurian period (~444–416 MYA) is best known for:

A) The K-T extinction event.
B) The origin of mammals.
C) The first land animals (e.g.
D) The first photosynthetic life.

BIOL 4230 — Practice Final — Conceptual-heavy · Variation D — Short Answer Section

Name _____

1. Reproductive isolation can be classified as prezygotic or postzygotic. (a) State the difference. (b) Give two examples of prezygotic isolation. (c) Give one example of postzygotic isolation. (d) Explain why reproductive isolation is central to the Biological Species Concept.

---

2. Define standing diversity and turnover rate. Then explain how the equilibrium theory of island biogeography (MacArthur & Wilson) predicts the relationship between island size, distance from the mainland, and standing diversity.

---

3. Match each key figure to their primary contribution to evolutionary thought, and briefly explain each contribution: (a) Lamarck, (b) Lyell, (c) Darwin, (d) Wallace.

---

4. Endangered species face both demographic and genetic threats. Briefly describe (a) ONE genetic threat to small populations, (b) ONE conservation strategy that addresses it, (c) ONE example of human activity directly imposing selection on wild species, and (d) ONE example of mismatch between wild adaptation and modern conservation interventions.

Answer Key for Practice Final — Conceptual-heavy · Variation D

1. C	11. D	21. C
2. D	12. A	22. B
3. B	13. A	23. C
4. D	14. C	24. B
5. C	15. C	25. C
6. B	16. D	26. A
7. A	17. B	27. B
8. B	18. D	28. D
9. A	19. D	29. C
10. A	20. D	30. C

Short Answer — Sample Answers

1. Reproductive isolation can be classified as prezygotic or postzygotic. (a) State the difference. (b) Give two examples of prezygotic isolation. (c) Give one example of postzygotic isolation. (d) Explain why reproductive isolation is central to the Biological Species Concept.

(a) PREZYGOTIC isolation acts BEFORE zygote formation, preventing fertilization. POSTZYGOTIC isolation acts AFTER zygote formation, reducing hybrid fitness. (b) Two prezygotic examples: TEMPORAL (e.g., two related plants flower at different times so pollen never crosses); BEHAVIORAL (e.g., different bird species have distinctive courtship songs that prevent inter-species recognition). Other prezygotic mechanisms include mechanical (incompatible reproductive structures), gametic (sperm/egg surface proteins don't match), and habitat (populations live in different microenvironments). (c) Postzygotic example: HYBRID STERILITY — horses and donkeys produce viable mules, but mules are sterile; the hybrid form exists but cannot reproduce. (d) Reproductive isolation is the heart of the BSC because the BSC defines species as populations that DON'T exchange genes. When two populations are reproductively isolated, gene flow stops, and they evolve independently — meeting Mayr's criterion for species status.

2. Define standing diversity and turnover rate. Then explain how the equilibrium theory of island biogeography (MacArthur & Wilson) predicts the relationship between island size, distance from the mainland, and standing diversity.

STANDING DIVERSITY is the number of species present in a given area at a given time. TURNOVER RATE is the rate at which species enter (via origination or immigration) and leave (via extinction or emigration) the community. The MacArthur-Wilson EQUILIBRIUM THEORY OF ISLAND BIOGEOGRAPHY models standing diversity as the equilibrium between immigration (which DECREASES as more species are already present) and extinction (which INCREASES as more species are present). Two key predictions follow: (1) LARGER islands have lower per-species extinction rates (more individuals, more habitat heterogeneity) → higher equilibrium standing diversity. (2) Islands CLOSER to the mainland have higher immigration rates → higher equilibrium standing diversity. The two effects (size and distance) operate independently, so the highest diversity is on large near-mainland islands and the lowest on small remote islands.

3. Match each key figure to their primary contribution to evolutionary thought, and briefly explain each contribution: (a) Lamarck, (b) Lyell, (c) Darwin, (d) Wallace.

(a) Lamarck proposed the INHERITANCE OF ACQUIRED CHARACTERISTICS — that traits gained during an individual's life are passed to offspring. The mechanism is wrong, but Lamarck deserves credit as the first to propose a systematic mechanism for evolutionary change. (b) Lyell, a geologist, argued for UNIFORMITARIANISM — that gradual, observable processes operating over DEEP TIME shaped Earth. He gave Darwin the temporal canvas needed for slow evolution to accumulate. (c) Darwin developed the theory of EVOLUTION BY NATURAL SELECTION through observations on the Beagle voyage and decades of subsequent work — variation + heritability + differential reproduction = evolutionary change. (d) Wallace INDEPENDENTLY CONCEIVED natural selection while working in the Malay Archipelago. His 1858 letter to Darwin is what finally spurred Darwin to publish, leading to the joint Darwin-Wallace paper that year.

4. Endangered species face both demographic and genetic threats. Briefly describe (a) ONE genetic threat to small populations, (b) ONE conservation strategy that addresses it, (c) ONE example of human activity directly imposing selection on wild species, and (d) ONE example of mismatch between wild adaptation and modern conservation interventions.

(a) GENETIC THREAT: Inbreeding depression — small populations have more relatives mating, increasing homozygosity and exposing deleterious recessive alleles, lowering fitness. Florida panthers exemplified this with heart defects and reproductive failure. (b) STRATEGY: GENETIC RESCUE — introducing individuals from a related, healthier population to add variation and reduce inbreeding. The Texas-into-Florida cougar program restored panther fitness. (c) HUMAN-IMPOSED SELECTION: Fisheries-induced evolution — minimum-size limits remove large fish before they reproduce, selecting for earlier maturation and smaller body size in heavily fished populations. (d) MISMATCH: Captive-bred animals adapted to captivity (calm around humans, less predator-wary) often have reduced survival when released; well-designed programs minimize captivity-specific selection.