Build a Mud Hunter

Designing an animal for a changing mangrove habitat

MAQ.7.7 "Enrichment: Given a niche in a specific environment, use an engineering design process to design an animal, listing characteristics based on your knowledge of shared and derived characteristics, internal and external anatomy..."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline traits shared with the fish ancestor, circle body features derived relative to that ancestor, and number the physiological processes that help the animal survive.

The Root-Runner Design

1. At the edge of a mangrove forest, the tide leaves muddy pools among tangled roots. Small shrimp become trapped there, but a hunter must cross wet mud to reach them. Imagine designing the root-runner, a fish descended from a swimming bony-fish ancestor. Its backbone, internal skeleton, heart, gills, and paired fins are shared with that ancestor. The design adds broad, muscular pectoral fins that prop up its body and a downward-facing mouth that can pick shrimp from shallow water. These new features are derived relative to the chosen ancestor, not traits found only in this imagined species.

2. Movement alone will not keep the root-runner alive when the tide falls. A larger gill chamber holds water around the gills, while moist skin with many tiny blood vessels allows oxygen to enter from air. Both surfaces must stay wet for gas exchange, so the fish shelters under roots instead of crossing dry, hot mud. At high tide, it swims and uses its gills in water. Because rain and seawater change pool salinity, cells in its gills adjust salt movement, and its kidneys adjust water loss in urine. These internal processes help keep body fluids stable.

3. An engineering team would first state the goal: catch shrimp in low-tide pools without drying out or losing control of body salts. Its first model has wide fins for crawling, but the fins create drag during high-tide swimming. The team tests movement in wet mud and water, then narrows the fins slightly and repeats both trials. They also use computer models to predict how gill-chamber size affects time active in damp air, while accounting for overheating. A successful design must balance feeding, movement, breathing, and salt control. No single trait solves every challenge in this niche.

2 ANSWER WITH EVIDENCE

Use the passage

1. Name two traits the root-runner shares with its ancestor. Which derived feature helps it reach shrimp across wet mud?

2. At low tide, how do one external feature and one internal feature help the root-runner stay active while it hunts?

3. Rain and seawater change the salinity of the pools. How do the root-runner's gills and kidneys respond, and why does that matter?

4. Why does the team narrow the first model's fins? Name the two conditions in which it tests the revised design.

3 YOUR TURN

Your own words

Design an animal that grazes algae on a wave-swept rocky shore at low tide. In one paragraph, name an ancestral animal group and two shared traits, then describe at least two derived traits, including an external structure and an internal structure or physiological process; explain how the traits help, and propose one test and a revision based on a possible result.

ANSWER KEY

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HIGH SCHOOL · MAQ.7.7

PART 1 · READ AND MARK

Underline traits shared with the fish ancestor, circle body features derived relative to that ancestor, and number the physiological processes that help the animal survive. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	Name two traits the root-runner shares with its ancestor. Which derived feature helps it reach shrimp across wet mud?	**It shares a backbone and gills with its ancestor. Its broad, muscular pectoral fins support its body as it crosses wet mud.**
2	At low tide, how do one external feature and one internal feature help the root-runner stay active while it hunts?	**Its broad pectoral fins help it move across wet mud. Its enlarged gill chamber holds water around the gills, helping it exchange gases while out of the pool.**
3	Rain and seawater change the salinity of the pools. How do the root-runner's gills and kidneys respond, and why does that matter?	**Gill cells adjust salt movement, and the kidneys adjust water loss in urine. Together, these processes help keep body fluids stable.**
4	Why does the team narrow the first model's fins? Name the two conditions in which it tests the revised design.	**Wide fins help with crawling but create drag during swimming. The team tests the narrower fins in wet mud and water.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

My animal descends from a marine snail with a shell and a muscular foot, traits it still shares with that ancestor. Its flatter, wider shell is a derived external feature that lets waves pass over it. Larger foot muscles are a derived internal feature that help it grip rock while it grazes algae. I would test whether it stays attached when water rushes over a model of the animal. If it slips, I would widen its foot and test again, while checking that it can still move between patches of algae.

Accept other passage-supported shared traits and low-tide feature combinations in Questions 1 and 2. For the open task, accept plausible designs that distinguish traits shared with a stated ancestor from derived traits and connect a test result to a revision.