Design for Survival

Trace how ancestry and habitat shape an animal design

MAQ.6.8 "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 characters, internal and external anatomy..."

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Circle two inherited characters, underline two proposed derived structures, and write P beside one physiological response to show how ancestry and habitat shape the fish.

A Fish for a Changing Pool

1. A mangrove creek at low tide can leave small pools of warm, cloudy water among roots. At night, animals and microbes use dissolved oxygen, while rain and evaporation can change salinity from day to day. Imagine an engineer designing a fish that hunts tiny shrimp in these pools. The first step is to define success: the fish must find prey in cloudy water, breathe when oxygen falls, and tolerate changing salt levels. No single feature solves every problem. A wide mouth might catch prey, for example, but it cannot keep the fish's cells at a stable salt balance.

2. The design begins with a ray-finned fish ancestor. Its descendants share a backbone, a bony internal skeleton, gills, and fins supported by rays. These inherited characters place the invented animal within that lineage; they are not new solutions to the pool. The engineer proposes a derived, capillary-rich lining inside the mouth that absorbs oxygen when the fish gulps air at the surface. The gills still take oxygen from water, but must stay moist to work. A broad tail and flexible body help the fish turn between roots. Neither body shape nor mouth lining changes its ancestry.

3. For prey detection, the engineer adds enlarged sensory pores along the head and sides. Water movement from a shrimp can stimulate the lateral-line system even when visibility is poor. To handle salt changes, the fish adjusts ion transport across its gills: it takes up ions in dilute water and releases excess ions in salty water. These functions cost energy, and rising to gulp air may expose the fish to birds. A test plan would compare feeding and survival in cloudy pools at different oxygen and salinity levels. If surface trips prove too risky, the engineer could shift hunting to times with fewer birds and retest.

2 ANSWER WITH EVIDENCE

Use the passage

1. Which inherited feature helps place the invented animal in the ray-finned fish lineage? Name one proposed derived structure that serves a different purpose.

2. How would the enlarged sensory pores help this fish fill its role as a shrimp hunter?

3. What physiological response helps the fish survive both rainy periods and periods when evaporation raises salinity?

4. What trade-off comes with gulping air, and what revision could the engineer test?

3 YOUR TURN

Your own words

Design a ray-finned fish for a cold, dark deep-sea sand plain where meals are rare. In one paragraph, name an inherited character, propose one derived external trait and one derived internal trait, explain a physiological response, and describe one trade-off with a test or revision.

Design for Survival

PART 1 · READ AND MARK

Circle two inherited characters, underline two proposed derived structures, and write P beside one physiological response to show how ancestry and habitat shape the fish. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	Which inherited feature helps place the invented animal in the ray-finned fish lineage? Name one proposed derived structure that serves a different purpose.	**Fins supported by rays are inherited. The proposed capillary-rich mouth lining helps the fish absorb oxygen from air.**
2	How would the enlarged sensory pores help this fish fill its role as a shrimp hunter?	**They help the fish detect water movement from shrimp when cloudy water limits visibility.**
3	What physiological response helps the fish survive both rainy periods and periods when evaporation raises salinity?	**It adjusts ion transport across its gills, taking up ions in dilute water and releasing excess ions in salty water.**
4	What trade-off comes with gulping air, and what revision could the engineer test?	**Surfacing may expose the fish to birds. The engineer could shift hunting to times with fewer birds and retest survival.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

My fish inherits a backbone from its ray-finned ancestors. Long, sensitive chin barbels are a derived external trait that help it locate prey on the dark seafloor. A larger, oil-rich liver is a derived internal trait that helps provide buoyancy without a gas-filled bladder at high pressure. Its slow metabolism reduces energy use when meals are rare. Storing oil may leave less energy for egg production. I would compare buoyancy and egg counts in fish with different liver oil levels, then favor the smallest oil reserve that keeps the fish near the bottom.

Accept other passage-supported inherited features and proposed structures in question 1. For the open task, accept plausible designs that distinguish inheritance from proposed derived traits and connect anatomy, physiology, a trade-off, and a test or revision to the deep-sea niche.