Borrowing a Beak

Use a bird adaptation to guide an engineering design.

ZOO.9.10 "Enrichment: Based on an understanding of biomimicry, use an engineering design process to develop a tool based on a bird's beak/feet to meet a human need.*"

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Circle the human need and underline the pelican feature that inspires the tool, then number these four engineering steps where they happen in the passage: revise, test, set criteria, build.

A Scoop Inspired by a Pelican

1 After a storm, floating plastic wrappers collect along the edge of a city pond. Volunteers can reach the wrappers, but ordinary nets also lift heavy loads of water. An engineer wants a hand tool that collects litter without making volunteers haul water. For a biological clue, she studies a pelican's bill. The loose pouch attached to the lower bill can expand to scoop fish along with water. Before swallowing, a pelican tilts its bill and lets water drain out. The engineer is not trying to copy an entire bird. She is studying how a flexible scoop can hold objects while releasing water.

2 She sets criteria before making anything: the tool must collect at least eight of ten floating plastic pieces in two minutes and stay light enough to lift with one hand. Her sketch shows a wide opening, a flexible mesh pocket, and a long handle. The pocket borrows the pelican pouch's expanding shape, while the mesh is a human-made change that lets water pass through. She builds a prototype from a bent wire rim, mesh, and a wooden dowel. Unlike a pelican, the tool does not need to catch moving fish, so its opening is shaped for slow sweeps through pond water.

3 She tests the prototype in a tank of pond water with ten clean plastic pieces. In two minutes, it collects six pieces. The pocket holds the litter, and water drains away, but the wire opening folds inward during each sweep. That failure points to the rim, not the pouch, as the part to change. She revises the tool by using a stiffer rim and attaching it more securely to the handle. In a second test under the same conditions, it collects nine of ten pieces in two minutes and still lifts easily with one hand. She records both results to compare the designs.

2 ANSWER WITH EVIDENCE

Use the passage

1. How does the tool use the pelican's pouch as a model, and what change helps it meet the volunteers' need?

2. Which collection criterion did the first prototype fail to meet? Use the test result to explain.

3. Why did the engineer change the rim instead of the pocket after the first test?

4. Did the revised tool meet both design criteria? Use evidence from the second test.

3 YOUR TURN

Your own words

In 5 to 6 sentences, propose a tool for a human need other than collecting floating litter. Name a bird and a feature of its beak or feet, explain how that feature shapes your tool, give a measurable success criterion, and describe a prototype test and a revision you would make if it fails.

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PART 1 · READ AND MARK

Circle the human need and underline the pelican feature that inspires the tool, then number these four engineering steps where they happen in the passage: revise, test, set criteria, build. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	How does the tool use the pelican's pouch as a model, and what change helps it meet the volunteers' need?	**The flexible pocket expands to hold litter, like the pelican's pouch holds fish and water. Its mesh lets water drain so volunteers do not have to lift it.**
2	Which collection criterion did the first prototype fail to meet? Use the test result to explain.	**It needed to collect at least eight of ten pieces in two minutes, but it collected only six.**
3	Why did the engineer change the rim instead of the pocket after the first test?	**The pocket held the litter and drained water, but the wire rim folded inward during each sweep.**
4	Did the revised tool meet both design criteria? Use evidence from the second test.	**Yes. It collected nine of ten pieces in two minutes, exceeding the collection target, and it was still easy to lift with one hand.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

A canoe camper needs a hand paddle that moves a small boat through a shallow channel. A duck's webbed feet spread a broad surface that pushes water backward, so my paddle would have a wide, flexible blade. I would build a prototype from a plastic sheet and a wooden handle. In a calm test pool, it should move the boat five meters in 30 seconds with one paddler. I would time three trips using the same boat and paddler. If the blade folds and the boat moves too slowly, I would add a thin support rib and repeat the test.

For the marking job, the step order is set criteria, build, test, revise. For Your Turn, accept other biologically accurate beak or foot models if the tool addresses a distinct human need and includes a measurable criterion, a test, and a revision tied to a possible failure.