Shade by Design

Model a biological strategy, then test whether it meets a human need.

ZOO.8.6 "Enrichment: Use an engineering design process to model biomimicry of ectothermic temperature regulation or chemosensory detection to meet a societal need.*"

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline the lizard behavior and circle the bench feature that copies it. Number the team's goal, test, and revision in the order they appear to trace the design process.

A Bench That Borrows from Lizards

1. At an outdoor bus stop, a metal bench can become painfully hot in afternoon sun yet feel cold on a winter morning. A local design team wants a seat that stays usable in both conditions without electricity. Many lizards are ectotherms: their body temperature is strongly affected by their surroundings. A lizard may move into sunlight to warm up and retreat to shade to avoid overheating. The team does not copy a lizard's skin or claim the bench is alive. Instead, it copies the lizard's choice between sun and shade. Their first idea is a hinged roof panel that riders can lock in either position.

2. The team sets two goals: on a hot day, the seat surface should stay below 35 °C, and on a cool morning, it should reach at least 20 °C when sunshine is available. They make two small, identical metal seats. One has a movable panel; the other stays uncovered as a comparison. For each trial, they expose both seats to the same conditions for the same time, then measure surface temperatures. In a hot-day simulation, the uncovered seat reaches 42 °C, while the shaded seat reaches 31 °C. In a cool-morning simulation, the uncovered seat reaches 22 °C, while the shaded seat reaches 17 °C.

3. The results suggest that shade helps on hot days, but leaving the panel over the seat on cool mornings works against the second goal. The team writes simple operating directions: lock the panel over the seat in strong heat, and swing it away when riders want the sun to warm the seat. A trial outdoors reveals another problem: wind can push the panel out of place. The team adds a locking pin and plans to repeat the temperature tests with the new hinge. They will also check that the panel stays out of the walkway and that riders can adjust it easily.

2 ANSWER WITH EVIDENCE

Use the passage

1. How does the panel imitate the lizard's behavior? What does each one help regulate?

2. Why does the team include an uncovered seat in each trial? What conditions must stay the same for a fair comparison?

3. Which panel position meets the hot-day goal in the simulation? Use the measured temperatures to support your answer.

4. Why would permanent shade fail to meet both temperature goals? What separate problem does the locking pin address?

3 YOUR TURN

Your own words

Design a biomimetic solution for a human need other than a bus-stop bench. In four or five sentences, identify an ectotherm behavior or an animal's chemical-sensing strategy, explain your device, give a measurable success target and a fair comparison test, and describe one change you could make if the first test failed.

ANSWER KEY

Shade by Design

PART 1 · READ AND MARK

Underline the lizard behavior and circle the bench feature that copies it. Number the team's goal, test, and revision in the order they appear to trace the design process. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	How does the panel imitate the lizard's behavior? What does each one help regulate?	**Both switch between sun and shade. The lizard regulates its body temperature, while the panel helps regulate the bench seat's surface temperature.**
2	Why does the team include an uncovered seat in each trial? What conditions must stay the same for a fair comparison?	**The uncovered seat provides a comparison for judging the panel's effect. Both seats must experience the same conditions for the same amount of time.**
3	Which panel position meets the hot-day goal in the simulation? Use the measured temperatures to support your answer.	**Shading the seat meets the goal: it reaches 31 °C, below the 35 °C limit. The uncovered seat reaches 42 °C.**
4	Why would permanent shade fail to meet both temperature goals? What separate problem does the locking pin address?	**On a cool morning, the shaded seat reaches only 17 °C, below the 20 °C goal, while the uncovered seat reaches 22 °C. The locking pin prevents wind from pushing the panel out of place.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

A dog's nose detects airborne chemicals and helps it follow a scent trail. To find a leak in a factory, my wheeled robot would compare readings from two chemical sensors and move toward the stronger signal. It must locate a safe test-vapor source within two minutes. I would compare it with a robot that uses only one sensor in the same room under the same airflow. If air currents mislead it, I would add a small fan to sample air at a steady rate.

Accept designs that connect a specific biological strategy to a human need and propose a measurable target, a controlled comparison, and a plausible revision. Students may choose either ectothermic temperature regulation or chemosensory detection.