Egg Shelter Lab

Design, test, and revise a practice incubator

ZOO.9.12 "Enrichment: Use an engineering design process to design and construct an incubator for hatching abandoned eggs.*"

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Underline the design requirements, circle materials or features that could meet them, and number the steps used to test and improve the prototype.

A Practice Incubator for a Wildlife Clinic

1. A wildlife clinic receives eggs that seem unattended. Staff first check whether adults are still caring for them; only authorized specialists decide whether rescue is needed. To prepare for such cases, a student team designs a training incubator using imitation eggs, not live ones. The clinic gives the team a target air temperature of 37.0 to 38.0 °C at egg height for its practice trial. A successful prototype must stay in that range for 60 minutes and allow staff to check humidity and airflow. Materials must cost under $35, and all electrical parts must use low voltage.

2. The team can choose a foam box or a clear plastic bin. Foam slows heat loss, while clear walls let staff see inside without opening the lid. They have a low-voltage heating pad, a thermostat that switches the pad on and off, two thermometers, a humidity sensor, a shallow water cup, and a small fan. Vent holes bring in fresh air, but large holes release heat and moisture quickly. Before construction, they sketch each part's location and keep electrical connections outside the box, away from water. They place thermometer probes at imitation egg height.

3. After building the prototype, the team runs it for 60 minutes with the lid closed and records temperatures every ten minutes. At the final check, the probe beside a vent reads 36.6 °C, while the probe across the box reads 38.3 °C. The team also sees water droplets on the lid, but the humidity sensor has not yet been read. They may change only one feature at a time, then repeat the test, so they can tell which change helped. A test with imitation eggs cannot prove that the device is safe for real eggs; specialists would need species-specific settings and oversight.

2 ANSWER WITH EVIDENCE

Use the passage

1. At the final check, how far outside the target range is each probe reading?

2. If the team chooses the foam box instead of the clear bin, what benefit and drawback should they weigh?

3. Why should the team's design include both a thermostat and vent holes? Explain the different job of each.

4. Propose one change that could reduce the difference between the probe readings. How should the team test whether it worked?

3 YOUR TURN

Your own words

Design a second prototype for a room that gets colder at night. In one paragraph of 70 to 110 words, choose a container, place the heat source, vents, and sensors, explain how you will check conditions without opening the lid, and give a test with a pass rule and one possible revision. Use imitation eggs, low-voltage parts, and a budget under $35.

ANSWER KEY

Egg Shelter Lab

HIGH SCHOOL · ZOO.9.12

PART 1 · READ AND MARK

Underline the design requirements, circle materials or features that could meet them, and number the steps used to test and improve the prototype. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	At the final check, how far outside the target range is each probe reading?	**The vent-side reading is 0.4 °C below 37.0 °C. The reading across the box is 0.3 °C above 38.0 °C.**
2	If the team chooses the foam box instead of the clear bin, what benefit and drawback should they weigh?	**Foam slows heat loss, but staff cannot see inside through its walls without opening the lid.**
3	Why should the team's design include both a thermostat and vent holes? Explain the different job of each.	**The thermostat switches the heating pad on and off to control warmth. Vent holes bring in fresh air.**
4	Propose one change that could reduce the difference between the probe readings. How should the team test whether it worked?	**Add the small fan to circulate air. Change only that feature, then repeat the 60-minute test with probes in the same locations and compare their readings.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

I would use the foam box to slow heat loss at night. A thermostat would control the low-voltage pad beneath the imitation eggs, with electrical connections outside the box. I would make small vent holes and place two temperature probes and a humidity sensor near egg height. Their readings would be visible outside the closed lid. Before building, I would check that the parts cost less than $35. When the room is cold, I would record both temperatures every ten minutes for 60 minutes. Both must stay between 37.0 and 38.0 °C. If they differ, I would add the fan and retest.

Accept other plausible single-feature revisions if students describe a repeat test at egg height. Part 3 designs should use the practice temperature range only for imitation eggs, not claim it is suitable for real eggs.