Designing New Skin

Compare scaffold designs using a model, then plan the next test.

HAP.3.4 "Enrichment: Use an engineering design process to design and model/simulate effective treatments for skin disorders (e.g., tissue grafts).*"

NAME _____ DATE _____

1 READ AND MARK

Read it twice

YOUR JOB Number the two scaffold designs, underline the model's success targets, and circle a limitation that calls for another test.

A Cover for a Burn

1. A patient has a deep burn on a forearm, and the damaged skin cannot provide a reliable barrier against microbes and water loss. A surgeon may use a thin layer of the patient's healthy skin as a graft, but taking donor skin creates another wound. An engineering team is exploring a scaffold seeded with living cells as an alternative, not as an approved treatment. Its design goal is to maintain coverage of a 20-square-centimeter wound through day 14 while limiting fluid loss. The team also sets two constraints: the covering must bend with the arm, and its living cells must be able to receive nutrients.

2. Before using living tissue, the team tests two scaffold designs in a computer simulation of a moving forearm. The model estimates coverage after repeated bends and fluid loss over 14 days; it does not predict whether a patient will heal. Design A, a thick gel sheet, retains 96 percent coverage and allows 8 milliliters of simulated fluid loss. Design B, a thin porous sheet, retains 88 percent coverage and allows 15 milliliters of loss. The team defines success as at least 90 percent coverage and no more than 10 milliliters lost in this model. Neither measurement shows whether the living cells would survive.

3. Design A meets both numerical targets, so the team selects it for another round of testing, not for immediate use on a patient. Its thick gel could prevent cells deep inside from receiving enough oxygen and nutrients before blood vessels grow into the scaffold. The next version uses a thinner gel with small channels intended to improve transport while keeping its flexible shape. The team would rerun the bend and fluid-loss simulation, then test cell survival in a laboratory model. Only later could carefully regulated studies examine safety and healing in people. A promising simulation is evidence for revision, not proof of a treatment.

2 ANSWER WITH EVIDENCE

Use the passage

1. Which design meets both model success targets? Use its results to support your choice.

2. If the team chose Design B, which targets would it miss, and by how much?

3. How does the team plan to revise Design A, and what risk is the change meant to reduce?

4. Why are the simulation results not enough to use Design A on a patient? Name one next test that addresses a gap.

3 YOUR TURN

Your own words

A clinic needs a cover for a shallow heel pressure injury that reduces friction and lets nurses inspect the area each day. In 5 to 6 sentences, propose two cover designs, give one measurable success target and one constraint, describe a safe model test comparing them, and explain how one possible result would lead you to revise a design.

ANSWER KEY

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HIGH SCHOOL · HAP.3.4

PART 1 · READ AND MARK

Number the two scaffold designs, underline the model's success targets, and circle a limitation that calls for another test. Accept any marking that follows this job and points at the right text.

PART 2 · ANSWERS

#	QUESTION	ANSWER
1	Which design meets both model success targets? Use its results to support your choice.	**Design A meets both targets: it retains 96 percent coverage, above the 90 percent minimum, and loses 8 milliliters, below the 10-milliliter maximum.**
2	If the team chose Design B, which targets would it miss, and by how much?	**Design B falls 2 percentage points short of the coverage target and exceeds the fluid-loss limit by 5 milliliters.**
3	How does the team plan to revise Design A, and what risk is the change meant to reduce?	**The team plans to make the gel thinner and add small channels to improve transport, reducing the risk that cells deep inside will lack oxygen and nutrients.**
4	Why are the simulation results not enough to use Design A on a patient? Name one next test that addresses a gap.	**The simulation does not show whether living cells survive or whether a patient will heal. Testing cell survival in a laboratory model addresses one of those gaps.**

PART 3 · YOUR TURN (SAMPLE ANSWER)

I would compare a clear gel pad with a clear film that has a soft fabric edge. Both designs must let nurses see a printed mark through the cover without lifting it. My success target is fewer than five snags during 20 simulated heel movements. I would place each cover over cloth wrapped around a foam heel model and count snags as it moves against a bedsheet. If the film snags seven times, I would try a smoother edge and repeat the test.

For Part 3, accept other plausible cover designs and safe models if the response includes a measurable target, the inspection constraint, a comparison, and a revision tied to a possible result.