Teacher's Key

Milk Without a Cow: The Science of Precision Fermentation (Level C1)

Vocabulary Matching

1 precision fermentation = **N**
2 bioreactors = **A**
3 feedstock = **H**
4 bioidentical = **L**
5 novel = **G**
6 land footprint = **M**
7 allocated = **I**
8 afforestation = **E**
9 peatland = **D**
10 comparable = **O**
11 mitigate = **J**
12 valorization = **K**
13 discrepancy = **B**
14 scarcity = **C**
15 viability = **F**

Fill in the Blank

1 bioreactors
2 feedstock
3 bioidentical
4 novel
5 land footprint
6 allocated
7 afforestation
8 peatland
9 comparable
10 mitigate
11 discrepancy
12 scarcity
13 valorization
14 viability

True or False

1 **True.** Paragraph 1 states it has been used since the 1990s to make a cheese-curdling enzyme.
2 **False.** The reading says they are trying to replace a share of the dairy industry itself.
3 **True.** Paragraph 2 says they are, at the molecular level, the same substance a cow would produce.
4 **False.** Perfect Day is described as an American company; Eden Brew is the Australian one.
5 **True.** Paragraph 3 states the study focused on land rather than the emissions most earlier assessments examined.
6 **False.** The reading names oilseed rape as the source of fat, not maize.
7 **True.** This figure is given directly in paragraph 4.
8 **False.** The reading says the land could go toward targets such as afforestation and peatland restoration.
9 **False.** The reading says consumption has risen sharply in both countries.
10 **True.** Paragraph 7 states the researchers call for further work on all three open questions.

Language Focus: Comparative Language for Scale and Proportion

Example answer: The new factory uses **roughly 40 percent less water** than the old one, largely because it recycles its cooling water instead of discharging it.

Comprehension Questions: Model Answers

1 Genetically engineered yeast or bacteria are grown inside the bioreactor and fed a sugar-based feedstock, which they convert over several days into a target protein.

2 Plant-based milks are recognizable as milk but chemically distinct from dairy, while precision-fermented protein is described as bioidentical: chemically identical to the protein a cow would produce, at the molecular level.

3 They calculated the land footprint, the area of land needed to produce one metric ton of milk, allocating cropland to protein, fat, and carbohydrate based on which crop would realistically supply each: sugar beet for carbohydrate and feedstock, oilseed rape for fat.

4 94 to 96 percent lower. The freed land could go toward UK climate commitments such as afforestation and peatland restoration.

5 The analysis used UK-specific data, including UK crop yields, UK dairy farming practices, and UK land use targets, and the authors themselves caution the numbers cannot simply be transferred to other countries.

6 Per-person milk consumption has risen sharply in both countries since 1961, over a thousand percent in India and well over two thousand percent in China. Because global demand is shifting toward such fast-growing markets outside the UK, whether similar land savings would apply there matters for the technology's overall impact, though the study says a separate country-by-country analysis would be needed to know by how much.

7 Any three of: water use, greenhouse gas emissions, the nutritional gap (including saturated fat) between fermented and cow's milk, the land used by the bioreactors themselves, and what happens to the leftover microbial biomass.

8 Open answer. A strong answer notes that the estimate leaves out several factors, such as bioreactor land and biomass disposal, that could only add to the resources required, never reduce them, so the true figure is unlikely to be lower than the study's estimate.

9 Open answer. A strong answer notes that starting with the mechanism, then a concrete national case, then a global comparison builds credibility before the limitations section, so the final paragraph's caution reads as measured rather than as an admission that the earlier findings were wrong.

10 Not Given. The study measured land only; the reading explicitly says it did not examine greenhouse gas emissions, so it cannot be used to support or reject a claim about them.

11 Not Given. The reading reports the study's estimates and cautions but never states a timeline or a belief that cow's milk will disappear; it explicitly lists open questions, including consumer acceptance, regulation, and scale-up, still to be resolved.

12 Best answer: to keep the finding in proportion. The sentence reminds the reader that a calculation is not the same as an outcome. Accept a reasoned answer about caution or tone, but the sentence does not dismiss the study's findings outright.

Notes on the Evidence

- The reading is based on a My Modern Met article (Linnea Pejcha, September 18, 2026) covering a study by Jade A. Warren, Elizabeth Ramos Fonseca, and Huw Woodward of Imperial College London's Centre for Environmental Policy, published in Frontiers in Sustainable Food Systems on February 27, 2026 (doi:10.3389/fsufs.2026.1692819). The reading was checked directly against the peer-reviewed paper, not only the news summary.
- Land footprint figures: the paper reports precision-fermented milk's allocation land footprint as 0.012 to 0.017 hectares per metric ton, against 0.294 hectares per metric ton for UK cow's milk, a 94 to 96 percent reduction (the paper's abstract rounds this to “as much as 96%”; 94 to 96 percent is the more precise range from its results and conclusion sections, which the reading uses). Land released under the three replacement scenarios: 851 to 866 thousand hectares at 20 percent replacement, 2,128 to 2,165 thousand hectares at 50 percent, and 4,257 to 4,330 thousand hectares at 100 percent. The reading uses the paper's own headline rounded figures of 859,000 and 4.29 million hectares, both from the abstract.
- The comparison to mainland Denmark's land area (about 4.29 million hectares) comes from the My Modern Met article rather than the paper itself. It checks out against mainland Denmark's land area of roughly 4.3 million hectares, but this was only a general geography check, not an independently sourced figure.
- The “nearly 80 percent” figure in paragraph 4 is the paper's own calculation that its Widespread Engagement scenario (50 percent replacement) would release about 79 percent of the land needed for its associated UK Climate Change Committee land use measures. This is called the more ambitious of the two official scenarios because the CCC's own Sixth Carbon Budget frames 50 percent replacement, not the 100 percent Total Replacement scenario, as its more demanding official dairy-reduction pathway; the paper treats full replacement as a theoretical maximum rather than a CCC recommendation.
- The saturated fat figures (8 percent of total fatty acids in rapeseed oil versus 64 percent in whole milk fat) are from the paper's Materials and Methods section, citing USDA (2019) and McCance and Widdowson's food composition tables (Finglas et al., 2015). The US discrepancy in paragraph 6 refers to a Tomorrow Farms life-cycle assessment (Planet FWD, 2023) reporting a fermented milk footprint of 0.002 hectares per metric ton against 0.037 for US cow's milk; the paper states it is unclear exactly how these US figures were calculated, and attributes part of the gap to US dairy systems having less pasture access and higher milk yields per cow than UK systems.
- Hindi and Arabic translations are unchecked by a native speaker, as with every EnglishBridges unit; the technical terms in this unit (valorization, bioidentical, precision fermentation, land footprint) are likely the least certain and worth a native check first.