TEACHER ANSWER SHEET

Final Assessment – Carbon During the Ice Age (CER)

Overall Question

How did Ice Age ecosystems affect where carbon was stored on Earth?

Correct Big Idea:

During the Ice Age, carbon was stored mostly in the **geosphere (soil and permafrost)** rather than the atmosphere because cold temperatures and grassland ecosystems prevented its release.

STEP 1 — CLAIM

Correct Answer to Circle:

✓ **Soil (permafrost/geosphere)**

(Students may also reasonably argue "plants (biosphere)" IF they clearly explain deep grass roots storing carbon — but the strongest answer is geosphere/permafrost.)

Acceptable Completed Claim Examples:

Ice Age ecosystems caused carbon to be stored mainly in the **soil (permafrost/geosphere)** because cold temperatures and grasslands prevented carbon from being released into the atmosphere.

Ice Age ecosystems caused carbon to be stored mainly in the **geosphere** because mammoths maintained grasslands that kept soil cold and carbon frozen.

STEP 2 — EVIDENCE ANSWERS

1. The article explains that Arctic permafrost contains:

✓ Large amounts of stored carbon
✓ More carbon than all living vegetation
✓ About twice as much carbon as is currently in the atmosphere

(Any of these is acceptable.)

2. If permafrost thaws, microbes release:

✓ Carbon dioxide (CO_2)
✓ Methane (CH_4)

3. Mammoths helped maintain:

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✓ Grassland ecosystems/Mammoth steppe/Steppe ecosystems

4. Grasslands reflect more:

✓ Sunlight/Solar radiation

and keep soils:

✓ Colder/Cooler

5. The carbon graph shows that during the Ice Age, atmospheric carbon levels were:

✓ Lower/Decreased/Much lower than today

STEP 3 — REASONING ANSWERS

Fill-in-the-blank key:

1. Photosynthesis removes carbon from the **atmosphere** and stores it in the **biosphere** (plants).
2. During the Ice Age, grasslands had deep **roots** that stored carbon in the **soil/geosphere**.
3. Mammoths helped keep the ecosystem as **grasslands** instead of forests.
4. Grasslands reflect more **sunlight / solar radiation** which keeps the soil **colder / cooler**.
5. Cold soil prevents **permafrost** from thawing.
6. When permafrost stays frozen, carbon remains in the **geosphere (soil/permafrost)** instead of being released into the **atmosphere** through **respiration** and **decomposition**.
7. Because more carbon stayed stored in soil, atmospheric carbon levels **decreased/stayed lower**

Model Cause-and-Effect Paragraph (Proficient Level)

During the Ice Age, carbon was mainly stored in the soil and permafrost instead of the atmosphere. Photosynthesis removes carbon dioxide from the atmosphere and stores it in plants and soil. Ice Age grasslands had deep root systems that stored large amounts of carbon underground. Mammoths helped maintain grassland ecosystems instead of forests. Grasslands reflect more sunlight, which kept the soil colder. Cold soil prevented permafrost from thawing. When permafrost remains frozen, carbon stays stored in the geosphere instead of being released into the atmosphere through respiration and decomposition. Because more carbon remained frozen in soil, atmospheric carbon levels were lower during the Ice Age.

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What Strong Answers Should Include

✓ Clear statement that atmospheric carbon was lower
✓ Explanation of permafrost as a carbon reservoir
✓ Role of mammoths in maintaining grasslands
✓ Grasslands → more reflection → colder soils
✓ Cold slows decomposition
✓ Carbon remains stored in soil
✓ Cause-and-effect chain clearly connected

Common Misconceptions to Watch For

Incorrect Idea	Correction
"Mammoths absorbed carbon directly."	Mammoths changed the vegetation structure.
"Grasslands increase CO_2."	Grasslands increase soil carbon storage.
"Permafrost releases oxygen."	Permafrost releases CO_2 and methane when thawed.
"Photosynthesis increases atmospheric carbon."	Photosynthesis removes CO_2.

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