

Carbon Account Book

Track carbon as it moves among Earth systems.

HIGH SCHOOL • HS-ESS2-6

HS-ESS2-6 "Develop a quantitative model to describe the cycling of carbon among the hydrosphere, atmosphere, geosphere, and biosphere. Clarification Statement: Emphasis is on modeling biogeochemical cycles that include the cycling of carbon through..."

NAME _____

DATE _____

TRACK INPUTS AND OUTPUTS

For one carbon reservoir, ending carbon = starting carbon + inputs - outputs. An input enters that reservoir, and an output leaves it for another Earth system.

WORKED EXAMPLE

An atmosphere reservoir starts with 810 Gt C. Ocean outgassing adds 35 Gt C. Photosynthesis removes 50 Gt C, and ocean uptake removes 15 Gt C. Find the ending amount.

1. Start: 810 Gt C
2. Input: +35 Gt C
3. Outputs: $-50 - 15 = -65$ Gt C
4. $810 + 35 - 65 = 780$ Gt C

Answer: 780 Gt C

PRACTICE 5 problems

- 1** Soil starts with 120 Gt C. Litter adds 18 Gt C, and respiration releases 11 Gt C. Find the ending soil carbon.

ANSWER _____

- 2** Surface ocean water starts with 400 Gt C. It absorbs 24 Gt C from air and releases 9 Gt C to air. Find the ending amount.

ANSWER _____

- 3** Plant biomass starts with 65 Gt C. Photosynthesis adds 14 Gt C, and decay transfers 6 Gt C to soil. Find the ending biomass carbon.

ANSWER _____

- 4** The atmosphere starts with 900 Gt C. Human emissions add 30 Gt C. Land removes 12 Gt C, and the ocean removes 8 Gt C. Find the ending amount.

ANSWER _____

- 5** Carbonate rock starts with 1,000 Gt C. Burial adds 16 Gt C, and weathering transfers 7 Gt C to the ocean. Find the ending rock carbon.

ANSWER _____

APPLY IT Show your work

- 1** A school garden's soil holds 54 kg C. Dead roots add 12 kg C. Microbes release 5 kg C to the atmosphere, and 3 kg C moves into groundwater. What is the ending soil carbon?

WORK SPACE

ANSWER _____

- 2** A lake near a sports field holds 90 kg C dissolved in water. It absorbs 16 kg C from the atmosphere, receives 7 kg C from soil runoff, and releases 11 kg C to the air. What is the ending dissolved carbon?

WORK SPACE

ANSWER _____

CHALLENGE One step up

CHALLENGE

A model begins with 760 Gt C in the atmosphere, 90 Gt C in plants, and 210 Gt C in soil. Plants take 28 Gt C from the atmosphere. Then 17 Gt C moves from plants to soil, and 9 Gt C moves from soil to the atmosphere. Find the ending carbon in each reservoir and verify the total carbon is unchanged.

PART 1 • PRACTICE

#	PROBLEM	ANSWER
1	Soil starts with 120 Gt C. Litter adds 18 Gt C, and respiration releases 11 Gt C. Find the ending soil carbon.	$120 + 18 - 11 = 127 \text{ Gt C}$
2	Surface ocean water starts with 400 Gt C. It absorbs 24 Gt C from air and releases 9 Gt C to air. Find the ending amount.	$400 + 24 - 9 = 415 \text{ Gt C}$
3	Plant biomass starts with 65 Gt C. Photosynthesis adds 14 Gt C, and decay transfers 6 Gt C to soil. Find the ending biomass carbon.	$65 + 14 - 6 = 73 \text{ Gt C}$
4	The atmosphere starts with 900 Gt C. Human emissions add 30 Gt C. Land removes 12 Gt C, and the ocean removes 8 Gt C. Find the ending amount.	$900 + 30 - 12 - 8 = 910 \text{ Gt C}$
5	Carbonate rock starts with 1,000 Gt C. Burial adds 16 Gt C, and weathering transfers 7 Gt C to the ocean. Find the ending rock carbon.	$1,000 + 16 - 7 = 1,009 \text{ Gt C}$

PART 2 • APPLY IT

1. **58 kg C** $54 + 12 - 5 - 3 = 58$. Root decay is an input, while respiration and groundwater movement are outputs.
2. **102 kg C** $90 + 16 + 7 - 11 = 102$. Atmospheric absorption and runoff are inputs to the lake.

CHALLENGE

Atmosphere: 741 Gt C; plants: 101 Gt C; soil: 218 Gt C. Total: $741 + 101 + 218 = 1,060 \text{ Gt C}$, unchanged from $760 + 90 + 210 = 1,060 \text{ Gt C}$.

Accept equivalent equations that correctly add inputs and subtract outputs. Require units and correct reservoir labels for the challenge.