

Model Connections

Read model results to trace human-caused Earth system change.

HIGH SCHOOL • HS-ESS3-6

HS-ESS3-6 "Use a computational representation to illustrate the relationships among Earth systems and how those relationships are being modified due to human activity..."

NAME _____

DATE _____

PART 1: READ MODEL CHANGES

A model output compares a starting value with a later value. Find change by subtracting: later value - starting value. For percent change, divide the change by the starting value and multiply by 100.

WORKED EXAMPLE

A climate model projects snow cover from 72 million km² to 60 million km². Find the percent change.

1. Change = $60 - 72 = -12$ million km².
2. Percent change = $-12/72 \times 100 = -16\frac{2}{3}\%$.
3. The negative sign means snow cover decreases.

Answer: 16 2/3% decrease

PRACTICE 5 problems

- 1** A published atmospheric model projects CO₂ from 400 ppm to 440 ppm. Find the change and percent change.

ANSWER _____

- 2** A published ocean model projects surface pH from 8.12 to 8.05. Find the change and name the Earth system.

ANSWER _____

- 3** A land model projects photosynthetic biomass from 500 Pg to 525 Pg. Find the change and percent change.

ANSWER _____

- 4** A sea-ice model projects ice area from 10 million km² to 8 million km². Find the percent decrease.

ANSWER _____

- 5** After more pavement is added, a runoff model projects annual river runoff from 200 km³ to 230 km³. Find the change and percent change.

ANSWER _____

APPLY IT Show your work

- 1** A student watershed group studies a published model of a tree-planting plan near its creek. The model projects runoff from 80 million L to 68 million L and sediment entering the creek from 16 tonnes to 12 tonnes. Find each percent decrease. Name the linked Earth systems.

WORK SPACE

ANSWER _____

- 2** A youth ocean club reads a published climate-ocean model. In a lower-emissions scenario, atmospheric CO₂ is 432 ppm instead of 480 ppm, and suitable coral habitat is 52% instead of 40%. Find the CO₂ percent decrease and the habitat change in percentage points. State the Earth-system chain.

WORK SPACE

ANSWER _____

CHALLENGE One step up

CHALLENGE

A published coupled model compares today with a high-emissions case: CO₂ changes from 420 to 462 ppm, land biomass changes from 300 to 312 Pg, and surface-ocean pH changes from 8.10 to 8.04. Write exactly two sentences that use the percent changes and explain why the biomass result does not mean there is no harm.

PART 1 • PRACTICE

#	PROBLEM	ANSWER
1	A published atmospheric model projects CO ₂ from 400 ppm to 440 ppm. Find the change and percent change.	40 ppm increase; 10% increase
2	A published ocean model projects surface pH from 8.12 to 8.05. Find the change and name the Earth system.	0.07 pH-unit decrease; hydrosphere
3	A land model projects photosynthetic biomass from 500 Pg to 525 Pg. Find the change and percent change.	25 Pg increase; 5% increase
4	A sea-ice model projects ice area from 10 million km ² to 8 million km ² . Find the percent decrease.	20% decrease
5	After more pavement is added, a runoff model projects annual river runoff from 200 km ³ to 230 km ³ . Find the change and percent change.	30 km³ increase; 15% increase

PART 2 • APPLY IT

- Runoff: 15% decrease. Sediment: 25% decrease. The biosphere, hydrosphere, and geosphere are linked.** Runoff decreases by $12/80 = 15\%$, and sediment decreases by $4/16 = 25\%$. Trees in the biosphere can reduce water-driven erosion between the hydrosphere and geosphere.
- CO₂: 10% decrease. Coral habitat: 12 percentage-point increase. Atmosphere -> hydrosphere -> biosphere.** CO₂ decreases by $48/480 = 10\%$. Habitat rises from 40% to 52%, which is 12 percentage points, through atmosphere, ocean water, and coral ecosystems.

CHALLENGE

The model links a 10% rise in atmospheric CO₂ to a 4% rise in land biomass, while ocean pH falls by 0.06 units. This shows that increased CO₂ can boost land photosynthesis but also acidify ocean water, harming the biosphere.

Accept equivalent percent forms when the direction is clear. For Earth-system links, accept scientifically accurate chains that include the relevant systems.