

Hillside Feedback Loop

Use field data to trace linked Earth-system changes.

HS-ESS2-2 "Analyze geoscience data to make the claim that one change to Earth's surface can create feedbacks that cause changes to other Earth systems. Clarification Statement: Examples should include climate feedbacks..."

NAME _____

DATE _____

1 READ AND MARK _____ Read it twice

YOUR JOB Underline each measured observation in the passage. Then number the changes in the feedback chain, starting with 1 at the surface change, so you can use evidence to support a claim.

A Changing Valley

- ① In a semi-arid valley, satellite images from 2005 and 2025 showed that ground vegetation covered 62 percent of a hillslope at first and 29 percent later. During the same period, average yearly runoff measured at a stream gauge rose from 18 to 31 centimeters. Soil traps at the bottom of the slope collected more sediment after heavy storms. Vegetation normally slows moving water, lets some water soak into the ground, and holds soil with roots. When shrubs and grasses were removed by repeated overgrazing, rainwater traveled downhill faster. The data connect a surface change, vegetation loss, to changes in the water and geosphere systems.
- ② Faster runoff did more than carry soil away. As erosion removed the darker, organic-rich topsoil, the slope stored less water after rain. With less water available near the surface, fewer plant seeds germinated during dry weeks. A field survey found 14 seedlings per square meter on the more eroded section, compared with 37 on a nearby section where topsoil remained. Fewer new plants meant less cover to slow later storms. Thus, the original loss of vegetation increased runoff and erosion, and those changes made it harder for vegetation to return. This is a positive feedback because the effects strengthen the initial surface change.
- ③ The effects can spread beyond the hillside. The extra sediment makes stream water muddy and can settle in channels downstream. A shallow channel carries less water before it overflows, so floods may reach nearby fields more often. The changes also affect people who use the valley. Farmers may lose fertile soil from their land, while a town may need to remove sediment from a water-storage reservoir. These observations support a claim about linked Earth systems, not simply a claim that erosion happened. The data show a chain: a biosphere change altered water movement, which changed soil and sediment in the geosphere, with further consequences for living things and human communities.

2 ANSWER WITH EVIDENCE _____ Use the passage

1 What was the first surface change in the valley, and which two numerical observations show that conditions changed after it?

2 Write the feedback chain from vegetation loss to conditions that make vegetation recovery harder. Include at least four linked changes.

3 Why does the passage describe this process as a positive feedback? Use one piece of passage evidence in your answer.

4 Write one evidence-based claim explaining how the loss of ground vegetation changed more than one Earth system. Cite two details from the passage.

3 YOUR TURN _____ Your own words

At Pine Marsh, wetland area fell from 120 hectares to 45 hectares after drainage ditches were built. Afternoon relative humidity fell from 68 percent to 54 percent, and the water table dropped from 0.6 meters to 1.3 meters below the surface. Write three sentences that make a claim, cite the data, and explain a feedback that could cause further wetland loss.

PART 1 • READ AND MARK

Underline each measured observation in the passage. Then number the changes in the feedback chain, starting with 1 at the surface change, so you can use evidence to support a claim. Accept any marking that follows this job and points at the right text.

PART 2 • ANSWERS

#	QUESTION	ANSWER
1	What was the first surface change in the valley, and which two numerical observations show that conditions changed after it?	The first surface change was loss of ground vegetation. Vegetation cover fell from 62 percent to 29 percent, and yearly runoff rose from 18 to 31 centimeters.
2	Write the feedback chain from vegetation loss to conditions that make vegetation recovery harder. Include at least four linked changes.	Vegetation loss led to faster runoff, which increased erosion and topsoil loss, which reduced water stored near the surface and seed germination, which produced less vegetation cover.
3	Why does the passage describe this process as a positive feedback? Use one piece of passage evidence in your answer.	It is a positive feedback because vegetation loss causes runoff and erosion, and erosion makes it harder for new plants to grow, strengthening the original vegetation loss.
4	Write one evidence-based claim explaining how the loss of ground vegetation changed more than one Earth system. Cite two details from the passage.	The loss of ground vegetation affected the biosphere, hydrosphere, and geosphere because runoff rose from 18 to 31 centimeters and erosion removed topsoil, reducing seedling growth.

PART 3 • YOUR TURN (SAMPLE ANSWER)

Loss of wetland area at Pine Marsh changed the atmosphere and water system, creating a feedback that can shrink the wetland further. The wetland declined from 120 to 45 hectares, while afternoon humidity declined from 68 percent to 54 percent and the water table became deeper, from 0.6 to 1.3 meters below the surface. With less wetland water available for evaporation, lower humidity can reduce moisture available for local rainfall and make it harder for the wetland to remain wet, reinforcing its loss.

Accept claims that accurately use the vegetation, runoff, erosion, topsoil, seedling, or sediment evidence to connect at least two Earth systems. For the open task, accept other scientifically reasonable feedback explanations that use all three Pine Marsh data trends and explain how the effects can reinforce wetland loss.