

Soil Quality Answer Key

1. Which soil is healthier?
the dark-colored soil
2. Explain your answer.
I can tell that the dark soil is healthier because the plants have grown better in that soil. Where there are more nutrients and moisture, plants will grow better.
3. What do you think are the important resources to follow in this model?
The important resources to follow in this model are topsoil, precipitation, and plant growth.
4. What processes are changing the availability of these resources in the model?
Topsoil is affected by the slope of the land, precipitation, plant growth, and tillage strategy. A bigger slope leads to more erosion, as does more precipitation. Plant growth can slow erosion of the topsoil. Tillage strategy affects how fast the topsoil erodes. When the roots are left in the soil by conservative tillage, the erosion rate is less. Disrupting/removing the roots allows more of the topsoil to erode away. Precipitation is not changed by any other resource in the model; it is set by the sliders. Plant growth is affected by the amount of topsoil. When there is less topsoil, the plants do not grow as well. This can lead to more erosion of the topsoil. Thus, plant growth is affected by the tillage strategy because the tillage strategy affects the erosion rate.
5. How should soil be tilled to preserve and enhance soil quality?
Soil should be minimally (or conservatively) tilled.
6. Explain why the tillage method you chose preserves soil quality.
When the soil was minimally tilled, more of the plants' roots stayed in the soil. After awhile, the soil quality increased because of the increased retention of organic matter (plant roots) in the soil. With intensive tillage, the roots were broken up and soil quality actually decreased from the starting conditions.
7. How certain are you about your claim based on your explanation?
Student answers will vary.
8. Explain what influenced your certainty rating.
Student answers will vary. Scientific evidence includes: high-quality soil has more organic material; plants' roots retained in the soil add organic material to the soil; and specific reference to experiments with the model.
9. What do you think are the important resources to follow in this model?
The important resources to follow in this model are topsoil amount, topsoil quality, precipitation, and plant growth.

Soil Quality Answer Key, continued

10. What processes are changing the availability of these resources in the model?
Topsoil quantity is affected by the slope of the land, precipitation, plant growth, and tillage strategy. A bigger slope leads to more erosion, as does more precipitation. Plant growth can slow erosion of the topsoil. Tillage strategy affects how fast the topsoil erodes. When the roots are left in the soil by conservative tillage, the erosion rate is less. Disrupting/removing the roots allows more of the topsoil to erode away. Topsoil quality is affected by the amount of organic material in the soil. The tillage strategy affects the amount of organic material in the soil. With conservative tillage, more roots are left in the soil, which maintains or slightly increases the soil quality. With intensive tillage, the roots are broken up and removed from the soil, which removes organic material; this results in a decrease in soil quality. Precipitation is not changed by any other resource in the model; it is set by the sliders. Plant growth is affected by the amount of topsoil and the quality of the topsoil. When there is less topsoil, the plants do not grow as well. When the soil quality is poorer, the plants don't grow as well either. This can lead to more erosion of the topsoil. Thus, plant growth is affected by the tillage strategy because the tillage strategy affects the erosion rate and soil quality.
11. Which tillage strategy leaves more roots in the soil?
conservative
12. Explain why the tillage strategy you chose leaves more roots in the soil.
When I selected conservative tillage, more of the plants' roots were left in the soil than with intensive tillage. Intensive tillage breaks up the plants' roots.
13. Which tillage strategy results in less erosion?
conservative
14. Explain why the tillage strategy you chose results in less erosion.
When there are more roots in the soil, the soil is held together better. When the soil is held together better, it is less likely to erode.
15. If there is a drought, in which soil will plant growth be least affected?
Soil B
16. Explain your answer.
Soil B is a higher-quality soil. Higher-quality soils hold more moisture. In a drought period, this is really important for plant growth. Soil A, with less moisture, would dry out quicker, leaving the plants starving for water. Soil B would dry out less quickly because it can hold more water, so plants would do better in a drought than in Soil A.

Soil Quality Answer Key, continued

17. How certain are you about your claim based on your explanation?

Student answers will vary.

18. Explain what influenced your certainty rating.

Student answers will vary. Scientific evidence includes: higher-quality soils can hold more water than lower-quality soils; higher-quality soils are darker than lower-quality soils because they have more organic matter; Soil B is darker than Soil A; and plants obtain moisture from their roots in the soil. Students may state that Soil B is darker than Soil A because of the types of sediments or because it recently received water, whereas Soil A has not had the same treatment.

19. Which crop would be good to plant after harvesting a wheat crop?

alfalfa

20. Explain your answer.

Alfalfa would be a good crop to plant after planting wheat because alfalfa adds nitrogen to the soil. The wheat plants have used nitrogen from the soil, but alfalfa can add it back, as can soybeans. Soybeans would also be a good choice, as they also add nitrogen to the soil. If the farmer is looking to minimize any fertilizer additives, soybeans might be a better choice than alfalfa because they require less phosphorus and potassium. Corn, wheat, and oats all require nitrogen to be added to the soil. All crops require additions of phosphorus and potassium if the soil doesn't have enough of those nutrients.

21. How certain are you about your claim based on your explanation?

Student answers will vary.

22. Explain what influenced your certainty rating.

Student answers will vary. Scientific evidence includes specific reference to the crop nutrient requirements in the table. Students may state that the levels of nutrients in the soil are unknown, so it's not clear what nutrients are there to support the growth of any of these crops.

23. Describe how a farmer might be able to avoid using inorganic fertilizers and still grow healthy plants.

A farmer could avoid using inorganic fertilizers by adding organic material to the soil. Organic material—plant roots, stems, and leaves—adds nutrients back to the soil just as inorganic fertilizers do. But the organic material also adds to the soil quality, helping the soil retain moisture and support the growth of plants' roots.

Soil Quality Answer Key, continued

24. Describe what the farmer can do to maintain and improve the soil quality of the farm.

To maintain and improve the soil quality of the farm, the farmer can prevent erosion of the fields by keeping plants planted in the soil. The farmer can also use minimal tillage to keep plant roots in the soil even when changing crops. The farmer should add organic material (plant waste) to the field to add nutrients to the soil and increase the soil's ability to retain moisture. Finally, the farmer should rotate the crops so that complementary crops go in sequence. Some crops can provide nutrients for other crops. This means that the farmer doesn't have to add as many (if any) fertilizers to get good crop growth.