Best Practices Answer Key

1. Which area of the world grows the most grain per unit of land area?
   North America

2. Note that there are occasional dips in the productivity of areas around the world. What do you think causes production per land unit to drop?
   The dips in crop yield could be due to bad weather conditions (low or high temperature; high or low precipitation) or to crop pests. Crops will not grow as well if the temperature is too high or too low or if the precipitation level is too high or too low. Crop pests could have destroyed large amounts of the crop, which would result in a decreased yield.

3. Could similar technique changes increase the yields of other crops? Explain.
   Similar techniques might be able to increase the yields of other crops. Farmers and scientists would need to test several different methods in the same year and same field to see which method yields the best crops. They should also test the methods over several different years to see if bad weather events affect each method differently. It is important to use the same field and same year in testing different methods so the soil is the same. Plants can grow very differently in different soils, depending on the nutrient levels and soil quality.

4. Based on the land models that you've used in this unit, explain why the SRI technique is important for the long-term health of the rice farm.
   The SRI technique is important for the long-term health of the rice farm because it returns organic matter to the soil. When organic matter is returned to the soil, the soil holds more moisture and soil quality improves. Improved soil quality leads to better plant growth in the future, and farmers want to make sure their fields are productive both now and in the future.

5. Many farmers choose to use genetically modified crops (such as Bt corn) rather than spray pesticides. How does this choice affect the soil quality of the land?
   Using Bt corn instead of spraying the corn with pesticides helps the soil quality. Without pesticide use, insects that live in the soil aren't accidentally killed. When there are more insects in the soil, there is more organic material in the soil. The soil quality might actually improve if pesticides aren't used, but at least it won't decline in quality.

6. Which method would you use to control pests?
   Student answers will vary.

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Best Practices Answer Key, continued

7. Explain your answer.
   Student answers will vary. Students should support their arguments with evidence.

   Chemical pesticides: Chemical pesticides are effective ways of killing many different kinds of pests, and the dangers to human and environmental health can be managed through careful and specific application. But chemical pesticides kill all insects equally—both pests and beneficial insects. Excess chemical pesticide application can run off into water supplies.

   Biological control: Biological control mechanisms are natural, using native organisms to combat pest organisms. Using biological control prevents the application of chemical pesticides, but there may not be biological controls available for every kind of crop pest. Some biological control options might not work in some climates.

   Genetically modified crops: Genetically modified crops avoid the application of pesticides that kill all insects equally. The crops are specific to kill only the targeted pest insect. But the pest insect may develop resistance to the protein in the GM crop. The extra protein in the GM crop may be harmful to people who are allergic to it.

8. How does monocropping affect pesticide use?
   More pesticides are used when monocropping.

9. Explain your answer.
   More pesticides are used when plants are monocropped because there is a larger food-fest available for crop pests when all of the plants are the same. There is less diversity in the plants, leading to less diversity in the insects, leading to a lower likelihood that the crop pests will be controlled by a natural biological predator. To prevent the pest insects from eating the crop, the farmer would have to apply pesticides.

10. Describe how a farmer could increase yields while decreasing pesticide use.
    A farmer could increase yields while decreasing pesticide use by planting different crops next to each other. If complementary crops are planted next to each other, they can help fertilize each other. This could lead to higher yields. In addition, having interleaved crops means the pests would not find a concentrated food-fest on which to feed and multiply. It's possible that one crop would attract insects that are natural predators of another insect that's a pest to a neighboring crop. Having the interleaved crops and potentially natural introduction of biological predators would decrease the amount of pesticides that need to be added to the field.

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Best Practices Answer Key, continued

11. Can the productivity of other regions reach the productivity of North America?
    yes

12. Explain your answer.
    Student answers will vary, depending on their choice to the previous question. Students should support their arguments with specific evidence from this activity and unit.

    YES: Every area can reach the same productivity as North America. The productivity in North America is largely due to the increased mechanization of agriculture, which has allowed farmers to plant vast fields of crops. This has been supported by chemical and biological innovations—chemical pesticides and fertilizers, biological modification of crops, and biological pest control. But there have also been innovations that don't rely on chemistry and biological changes. SRI found that just by planting rice in a different way, farmers were able to increase yields in places other than North America. There are plenty of other innovations just waiting to happen. Other regions of the world can learn from what has worked in North America, but they can also develop methods of their own that work even better.

    NO: Every area of the world doesn't have the same soil quality. Some soils are better suited to growing specific crops than others. The yields of cereal crops in other areas of the world may never reach the yields seen in North America, but yields of other crops could surpass yields of those crops in North America. Since much of the productivity increase in North America is due to mechanization of agriculture, the yields in other areas, particularly poor areas, might not be possible. Poorer farmers may not be able to afford all of the equipment necessary to replicate what happened in North America. The same is true of the chemical pesticides and fertilizers that have helped increase North America's yields.

13. How certain are you about your claim based on your explanation?
    Student answers will vary.

14. Explain what influenced your certainty rating.
    Student answers will vary. Scientific evidence includes specific references to any material in this activity or unit. Students may state that other regions of the world can't afford to increase their crop yields the way North America did. They may also note that soil qualities may not be the same around the world and/or that some crops will grow better in some areas of the world than other crops.

15. What do you think of genetic modifications to enhance nutrition?
    Student answers will vary. Students should support their arguments with scientific evidence.

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Best Practices Answer Key, continued

16. Which crop should be planted in each field?
    Field 1: corn
    Field 2: wheat
    Field 3: soybeans
    Field 4: cherries

17. Explain how the farmer should manage the four fields to ensure a good yield of each crop over the next 20 years.
    Leave the cherries alone on the hill (Field 4). The trees will prevent erosion from the steep hill. Rotate other crops and don't till too much so the soil quality is maintained or improved. Soybeans should be planted after corn and after wheat to add nitrogen back to the soil. Leave roots in the soil after harvesting corn, wheat, and soybeans to prevent the soil from eroding during the winter (non-growing) months. Keeping the roots in the soil will make sure the topsoil stays in place, and the roots will rot in the ground, adding to the soil quality. Add waste plant material to the fields to add nutrients and build up the topsoil.

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