

Reflection Section Answer Guide

Chip Off The Old Block

Introduction

- **What is the question the scientists wanted to answer?** *Would school districts save money if they used wood for heating instead of their usual way of heating schools using fossil fuels?*
- **What would the scientists have to do to answer their question?** *Although students may come up with many ideas, they should identify at least three things: Current heating costs at the schools must be understood, a new wood burning heating system would have to be built at the schools, and costs of the new system must be tracked.*

Method

- **Should the scientists include the following costs in their calculations: The cost of cutting trees, the cost of transporting cut trees to a mill for cutting into chips, and the cost of transporting the wood chips to the school? Why or why not?** *Yes, since these are real costs associated with biomass heating, they should be included in the scientists' calculations.*
- **Biomass heat, which comes from wood chips, is considered a renewable natural resource because trees can be replanted. What is one advantage of using biomass energy over a nonrenewable resource such as oil? What is one disadvantage?** *Renewable resources can be sustainable into the future, since trees and other biomass energy products can be replanted. In this case, the trees were being cut anyway, and this provides a way to use them for human benefit. A possible*

disadvantage is if too many trees are cut for biomass heat energy, there will be fewer trees to provide benefits such as carbon sequestration, wildlife habitat, and protection from soil erosion.

Findings

- **Look at table 1. You can see the cost of oil had risen between 2003 and 2005, and, therefore, the cost savings rose over the 2 years. Based on what you know about oil prices now, do you think the cost savings for Darby Schools went up, down, or stayed the same during the last school year as compared with 2004–2005?** *Fuel prices have been rising annually, therefore, students should conclude that the cost savings associated with using biomass heat energy should be steadily climbing. The answer to this question, however, will depend on whether fuel prices are currently higher or lower than prices in 2004–2005.*
- **Do you think the cost savings would be the same for a school located in Kansas as in Montana? Why or why not?** *You may have to help your students think this through. There are not as many forests nearby in Kansas as there are in Montana. Therefore, wood chips would have to be transported to the school, raising the cost of biomass heating for Kansas' schools. While it is unknown whether there would be cost savings, it is clear that any costs savings would have to be less in Kansas than Montana.*

Discussion

- **Should the cost of replacing a conventional heating system with a new biomass system be considered when**

calculating cost savings? Why or why not? *Yes, because these costs are real.*

- **Should the cost of building a new biomass heating system at a new school be considered when calculating cost savings? Why or why not?** *Not necessarily. If total cost savings are to be calculated, one could compare the cost of building a conventional oil heating system with the cost of building a biomass system. Then, the operational costs could also be compared. Otherwise, it is probably okay just to compare estimated costs of heating with oil with actual costs of heating with biomass energy.*

Which Do You A-door?

Introduction

- **In your own words, state the question the scientists wanted to answer.** *Does the process up to and including the manufacture of a wood door strengthened with fiberglass or a steel door use more energy and create more waste?*
- **Where do people get the raw materials they need to manufacture products?** *From natural resources that came from Earth.*

Method

- **The scientists included the energy used and emissions produced when the raw materials were collected, as well as the manufacture of each door. Why do you think they included the gathering of raw materials in the life-cycle inventory?** *If the scientists wanted to compare the total amount of energy used and emissions produced in the manufacture of each door, they would have to include the energy used and emissions produced to harvest or mine the raw materials and transport them to a manufacturing plant.*
- **Do you think the scientists found it takes more energy to manufacture a wood door or a steel door? Why?**

Students will have to use their own critical thinking skills to determine which door they think is more environmentally sound in the manufacturing process. Whatever students report, they should support their conclusion with logically derived reasons.

Findings

- **Examine tables 1–5. What conclusion can you make about the production of a steel door in comparison with the production of a wood door?** *Students should see that more energy is used and waste products produced in the manufacture of a steel door as compared with a wood door.*
- **Based on the findings you have just read, what would you predict about the environmental impact of manufacturing a steel table compared with manufacturing a wood table?** *Students should predict that the manufacture of a steel table would take more energy and produce more waste products than the manufacture of a wood table.*

Discussion

- **This life-cycle inventory showed that more energy is used and more waste produced in the manufacture of a steel door. What might be one advantage of using a steel door instead of a wood door in your home? Do you think this advantage of using a steel door outweighs the disadvantage of its greater environmental impact? Why or why not?** *One advantage of using a steel door might be its greater resistance to burglary. With added fiberglass, however, wood doors are made much stronger. Hold a class discussion about the relative importance of the advantages and disadvantages of steel and wood doors.*
- **If you were employed by a home improvement store in your community, what would you tell a homeowner who**

has come into your store wanting to buy a new door for his or her home? *Students will have to answer this question on their own. They should, however, be able to restate the findings of this research and integrate information from the class discussion held as a part of the reflection question above.*

Chip and Truck

Introduction

- **What question did the scientists want to answer?** *What are the costs, revenues, and benefits of using woodchips for thermal energy, and how does using woodchips compare with burning small trees on the forest?*
- **What are the sources of the two types of fuel being compared in this study? Which of these fuels is renewable?** *Diesel fuel to cut and haul the woodchips comes from oil; and thermal energy comes from woodchips cut from small trees. The woodchips are renewable because new trees can be grown.*

Method

- **Whenever people make a choice to do one thing rather than something else, there are costs and benefits to each choice. Think about a choice you recently made. Identify the costs and benefits of that choice, compared with another choice you could have made instead. Remember that costs involve more than just money. For example, time, or even the loss of a friendship, can be considered a cost.** *This is an individual question, and each student will have to answer for him or herself. The important point here is to emphasize how people analyze (or should analyze) costs and benefits before making a decision. You may want to use the example of risky behavior as something to be carefully analyzed before a decision is made.*

- **In this study, there is one cost in particular that continues to rise. What is that cost? How do you think this cost might affect the scientists' results if they did this study next year?** *Fuel costs continue to rise. Students should be encouraged to think beyond the costs of cutting trees and woodchips and hauling them. They should also consider the rising costs of conventional heating and how heating with thermal energy from woodchips may offset some of the rising fuel costs.*

Findings

- **Look at figure 6. Where does most of the revenue come from in this situation?** *Most of the revenue comes from selling the larger trees to a mill.*
- **It makes sense to cut trees into woodchips when facilities that can use woodchips are located close by. However, few of these facilities currently exist. As fuel costs rise, in what ways might this situation change?** *This is a good group or class discussion question. Students should realize that as fuel costs rise, hauling costs will rise. Heating oil costs will also rise, making woodchips more attractive. Some possibilities are that more woodchip facilities will be built in areas close to forests, making it more economically feasible. If hauling costs continue to rise and more facilities are not built close to forests, it may remain difficult to make woodchip heating feasible. Students should be encouraged to consider a number of options for the future in which woodchips might be a good option for some kinds of energy.*

Discussion

- **The scientists pointed out a dilemma that could be faced in the future. What is that dilemma?** *To make the use of woodchips for energy more economically*

feasible, more woodchip facilities need to be built near forested areas. As more small trees are cut and the forest regains its health, fewer small trees will be available to fuel the woodchip facilities. Thus, it is possible that, in the future, there will be a shrinking supply of small trees to cut into woodchips and use in the facilities.

How Now Round Crown?

Introduction

- **What larger social issue does this research address? (Hint: it has to do with something we use everyday for just about everything we do.)** This research addresses the energy issue. How does it address this issue? This research attempts to provide information about whether it is reasonable to use southern pine tree crowns as an energy resource.
- **Describe the questions the scientists wanted to answer.** This is a question that should help clarify whether students understand the research questions. Students should understand that the scientists were exploring how tree crowns might be used for energy and the effect of different ground treatments on future energy availability.

Method

- **The scientists used information that had been previously calculated by others. For the scientists' research to be accurate, what do you think they needed to do and how they should feel about this information?** The scientists would need to check the accuracy of the information they were about to use. They must feel confident the information they were using was accurate. When you have not calculated the information yourself, you must

be as certain as possible that it is accurate. **In what ways do you or should you do the same thing when accessing information over the Internet?** One should not consider information factual just because it was found on the Internet. Multiple sources should be compared and contrasted. Sites with extensions of .gov and .edu should be used if possible. These are governmental and educational institution sites.

- **What three things were the scientists comparing in this study?** The amount of extra energy available for use in 10-year old trees growing in three different situations. In the first situation, the tree crowns would not be available for use. In the second, the crowns would be available, but the ground had not been fertilized before planting. In the third, the crowns would be available and the ground had been fertilized before planting.

Findings

- **Look at the last column. Why do you think the third plot shows a much higher energy potential than the second plot?** Because the fertilization helped the trees to grow larger and, therefore, provide more biomass that can be used to create energy.
- **In 10 years, tree crowns might be an important source of energy. Based on this research, what one thing would you recommend to someone wanting to plant southern pine trees for energy?** Fertilizing the ground is important if you want to grow larger and healthier trees.

Discussion

- **Imagine you are living 10 years in the future. Do you think energy from tree crowns will be more or less important than it is now? Why or why not?** Students may have a variety of opinions about this. Whatever they say, they should have logical reasons for their position.