

Saving the Environment with Economic Ideas

Lesson 6: Green Is the New Gold

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Standards and Benchmarks (see page 6.18)

Lesson Description

In this lesson, students work in groups to solve an issue that businesses face: Resources used in the production process are scarce, and it can be expensive to throw away a lot of waste, especially since many industries depend on the same resources. There are two rounds in which students will assess the production process for toy wooden shapes. In the first round, students are presented with an inefficient use of resources and the production costs, revenue, and profit associated with it. In the second round, students brainstorm the most creative and efficient way to use a resource while increasing production, reducing waste, and increasing profits; students actively participate and calculate how they can do all three. The lesson closes with a case study on land tipping fees and questions for discussion.

Grade Level

High school

Concepts

Capital
Factors of production
Fixed costs
Innovate
Labor
Land
Opportunity cost
Profit
Revenue
Scarcity
Total cost
Variable costs

Objectives

Students will be able to

- define capital, factors of production, fixed costs, innovation, labor, land, opportunity cost, profit, revenue, scarcity, total costs, and variable costs;
- explain why the factors of production are necessary for the production of goods and services; and
- analyze how businesses can increase and improve their production process while capturing waste, or reducing it significantly, and increasing profitability.

Compelling Question

How can companies reduce waste, and increase profit, while the costs of production rise?

Time Required

60-75 minutes

Materials

- PowerPoint Slides 6.1-6.14
- Handout 6-1, one copy for each group of two to four students, and two extra copies for the teacher, all printed on cardstock
- Handout 6-2, one copy for each group of students, printed on cardstock
- Handout 6-2 Sample Answers, one copy for the teacher
- Handout 6-3, one copy for each group of students
- Handout 6-3 Sample Answers, one copy for the teacher
- Handout 6-4, one copy for each student
- Handout 6-5, one copy, cut apart, and one uncut copy for the teacher
- Two pairs of scissors for each group of students (or students can use their own scissors to make cutting faster)
- One calculator for each group of students
- Clear resealable sandwich bags, one for each group of students
- Small scale that weighs in grams (can be borrowed from a science teacher)

Introduction

“Reduce, reuse, recycle” are now the three Rs of business. Being innovative and taking the “green” approach to doing business have increased in priority for businesses today. With waste-limiting laws, public image concerns, and scarcer resources, businesses are innovating and finding very profitable ways to produce more and waste less. Businesses are becoming aware that what they are wasting has value. By capturing the waste, they save on both money and materials. Today’s leaders in green initiatives are also making big profits because of their efforts in being less wasteful and more mindful.

Procedure

1. Tell the students they will be participating in a production simulation. Before beginning the simulation, ask the students to think about some of the items they have with them and what materials were needed to produce those goods. Instruct the students to pick an item and describe the resources. Record their responses on the board. (*Answers will vary. Example responses may include a T-shirt made of cotton; a pen consisting of plastic, ink, a small spring, and a metal tip; paper made from trees; or bottled water consisting of plastic and filtered water.*)
2. Display Slides 6.2-6.5. Explain to the students that every type of industry depends on three essential resources to produce their good or service. These resources are land, labor, and physical capital. They are known as the factors of production. As you review each slide, be sure to emphasize the examples given for each type of resource as follows:
 - **Land:** Things that occur naturally in and on the earth that are used to produce goods and services. Examples include oceans, air, mineral deposits, virgin forests, and actual fields of land. Land resources are also called natural resources. When investments are made to improve fields of land or other natural resources, those resources become, in part, capital resources.
 - **Labor:** The quantity and quality of human effort available to produce goods and services.
 - **Capital:** Resources and goods made and used to produce other goods and services. Examples include buildings, machinery, tools, and equipment.
3. Display Slide 6.6. Explain that the factors of production come at a cost to producers. The payment for each of the resources is listed on the slide.
4. Display Slide 6.7. Explain that producers have **fixed costs** and **variable costs**. Review the information on the slide.
5. Display Slide 6.8. Discuss the definition of **scarcity** and how it applies to the factors of production. It is because of scarcity of these resources that an economy cannot produce an endless

amount of goods and services. Society's wants for goods and services are unlimited, but we face scarcity; that is, the resources needed to produce all the goods and services we want are limited.

6. Display Slide 6.9. Explain that because of scarcity—wants exceeding the supply of resources—producers must make choices about how to maximize their resources in the production process. Every choice results in a cost, something that is given up. In economics, the highest-valued or most-important option that is given up when a choice is made is referred to as **opportunity cost**. Discuss the following:
 - Give some examples of resources that are increasingly scarce. (*Answers may include oil, fresh water, land, metals, or trees.*)
 - What happens as these resources become scarcer? (*Producers can't produce as many goods and services.*)
 - What happens if producers don't produce goods and services efficiently with these resources? (*Fewer goods and services are produced and resources are wasted.*)
 - What will happen to the price of these resources? (*The price of the resources will increase.*)
 - What will happen to the price of goods and why? (*The price of goods will increase because as producers pay more for their resources, they mostly cover the increased production costs by increasing the price of their goods.*)
7. Explain that when the price producers pay for resources increases, producers earn less **profit** unless they raise the price for which they sell their goods and services. Display Slide 6.10. Explain the definitions and calculations for **revenue** and profit. Tell students that they must know how to do these calculations for the simulation.
8. Arrange the class into groups of two to four students, depending on class size and amount of materials available. Explain that they are all producers of wooden toys. The toys they are producing today are educational toys—shapes for kids. Each group represents a separate company that produces the same type of toys. Because they all make wooden toys, every producer depends on the same resource—wood.
9. Distribute a copy of *Handout 6-1: Round 1—Shapes*, a copy of *Handout 6-3: Calculations Worksheet*, a clear resealable sandwich bag, and a calculator to each group. Distribute two pairs of scissors to each group or ask the students to use their own scissors. Explain that the box on Handout 6-1 represents a sheet of plywood and the number of toy pieces (30) currently being produced from one sheet of plywood this size.
10. Refer to Handout 6-3 and review the costs of production for Round 1 with the students. Explain that given the current supply of wood, each producer will pay \$2.50/sheet, and each

group will work with only one sheet for each round. The variable cost for this round will be the waste disposal fee. Calculations will be completed after students complete Step 12 below.

11. Explain that the wooden shapes are sold in sets of three—a triangle, a square, and a circle. For Round 1, each group will work together to cut out each shape and group each set together. As they cut, students should place all the excess paper in the resealable sandwich bag. This represents the waste that results from their production. Allow time for the students to cut out the shapes.
12. Ask the students how many sets they were able to produce from the one sheet. (*Students should answer 10 sets.*) Have the scale ready and tell the students to choose one person from each group to come up with the bag of waste and calculations worksheet. Weigh each group's bag of waste and remind them to record the weight and calculate the **total cost** of waste on Handout 6-3, Line C.
13. Using their calculators (if needed), students should complete Handout 6-3 for Round 1. *Handout 6-3: Calculations Worksheet—Sample Answers* provides an example of what the costs would calculate to if the waste disposal weighed 6 grams. Discuss the following:
 - Look at your bags with the wasted resources. Did disposing the waste cost anything? (*Yes, we paid \$0.50/gram for disposing the unused portions of wood/paper.*)
 - How many grams of waste did you have and what was your cost? (*Answers will vary but could range from 6-8 grams and cost between \$3 and \$4.*)
 - How could you save some of these costs? (*By having less waste*)
14. Ask the students if any group would like to produce more shapes. Hold up the two extra copies of Handout 6-1 and announce that there is an increased demand for wooden shapes. Discuss the following:
 - What will happen to the price of a sheet of plywood as a result of increased demand? (*The price will rise.*)
 - What effect will this have on their costs of production? (*Their costs will rise.*)
 - What will happen to their profit if they continue to sell shapes at the same price? (*It will decrease their profit.*)
15. Distribute one copy of *Handout 6-2: Round 2—Blank* to each group. The blank box represents a sheet of plywood used in the production of wooden shapes. The wood that is used to produce the plywood sheets has become scarcer. As a result, the price of plywood has increased to \$3 per sheet, and the waste disposal fee has increased to \$0.55. Each set of shapes is still selling for \$4.

16. For this Round 2, group members will work together to **innovate** a new pattern for positioning the shapes to maximize their resources and produce more sets that consist of a square, a triangle, and a circle. Students will use one of the sets already produced to trace their patterns on Handout 6-2 so that they are the same size as those produced in Round 1.
17. Explain that their goals are to maximize their scarce resource of plywood, decrease their waste disposal fee by wasting less, and increase their profit even though the cost of the plywood sheets has increased. Students should be sure to produce full sets of shapes as they innovate so that they do not have shapes left over. Have students empty the waste from their bags and put aside their shapes from the first round, except for one set to be used for tracing in Round 2. Students will place the new waste in the emptied plastic bags. Allow time for the students to innovate, trace, and cut out their new sets. Refer to *Handout 6-2: Round 2—Sample Answers* for a possible layout of the shapes. NOTE: It is strongly encouraged that the teacher walk around the room to check each group's progress.
18. Have the scale ready and tell the students to choose one person from their group to come up with the bag of waste and calculations worksheet. Weigh each group's bag of waste and remind students to record the weight and calculate the total cost of waste on Handout 6-3, Line C for Round 2.
19. Review Handout 6-3, Round 2 with the students, allowing time for the groups to work on their calculations. Walk around the room to make sure students are completing the calculations correctly. Handout 6-3 Sample Answers has a sample response using 21 sets of the shapes from Handout 6-1. Discuss the following:
 - Were you able to increase your profit in Round 2? (*Students should report a higher profit if they were able to produce more sets.*)
 - Share with the class your innovative strategies for maximizing the amount of sets you produced. (*Answers will vary.*)
 - Are there alternative uses for the waste in the bags? (*The pieces could be recycled.*)
20. Explain that unstained, engineered woods like plywood can be sent to recycling plants where they are shredded into compost or mulches. Recycling is a very effective way for businesses to decrease their waste and costs because recycling plants usually collect the material at little to no cost.
21. Explain that some companies capture their waste. Capturing waste means taking the waste produced in one part of the production process and using it in another part of the production process. It is a form of recycling. Some students may have some knowledge or ideas about how the waste from the activity could be captured. Discuss the following:

- Considering the definition of capturing waste, what are some ways the extra wood pieces in your bags could be captured for energy? (*Answers will vary. Students may suggest the wood pieces could be burned and used as a form of energy for the business, keeping in mind that the wood does not contain contaminants that are harmful when burned.*)
 - If wood chips are not needed, how can other manufacturers use the wood pieces? (*Answers will vary. One way is to sell the leftover pieces to a manufacturer of particle board, which is engineered wood from different scraps of various types of wood.*)
22. Explain that, just as the students did in the activity, many businesses consider their production processes so that they make the most of their resources while increasing productivity and profits. Businesses today need to add environmental thinking to their production strategies.
23. Distribute a copy of *Handout 6-4: Case Study* to each student. Tell them they will be reading a case study that explains what land tipping fees are and gives examples of how some companies have made reducing waste a top priority, which has proved to be efficient, effective, and—most of all—profit increasing. Allow time for the students to read the case study and answer the comprehension questions, and then review the answers as follows:
- What are land tipping fees? (*Land tipping fees are charges to businesses by waste management companies for the pick-up, removal, sorting, and other operations associated with the waste management process.*)
 - Explain how Apple Inc. increased recycling in its production process. (*When building its new campus, Apple Inc. implemented an effective recycling program that saves the company \$1 million per year. In the manufacturing process of all iPhones and Apple watches, recyclable materials are sorted within the production line itself. The company is putting forth many efforts and innovations to have zero waste from the development, production, and selling stages in its production process.*)
 - What are some reasons businesses are increasingly more aware of their waste disposal? (*Businesses look for ways to reduce their production costs, and by decreasing the amount of waste they produce, they can cut what could be a significant cost. Capturing waste has proved to be a more profitable venture than wasting.*)
 - Calculate how much a company would have to pay in land tipping fees if a small manufacturer of wooden puzzles has 200 tons of waste and the land tipping fee is \$85 per ton. (*\$17,000*)
 - If the wooden puzzle manufacturer hires you as a consultant to study and provide solutions for greener production methods that could decrease its waste and land tipping fees, what solutions might you suggest? (*Answers will vary. Suggestions could include getting together with other producers that use the same resource and coming up with more efficient ways to use the resource. The business could also recycle the excess wood by using it in another product or find ways to maximize every piece of material so that very little, if any at all, is wasted.*)

24. Display Slide 6.11. Discuss some highlights about land tipping fees.
25. Display Slides 6.12-6.14. Referring to Slide 6.12, ask the students if they know what the companies listed produce. (*Tesla: all-electric, zero-emissions cars; Chipotle: burritos and fast, casual dining; Toyota: automobiles; GE's Ecomagination: GE makes industrials such as aircraft engines, power generators, medical imaging machines, and oil and gas production equipment. Ecomagination is the name of their strategic plan to reduce their impact on Earth; Patagonia: outdoor clothing*) Point out that more and more companies are learning that using resources wisely and reducing waste has proved to be very profitable.

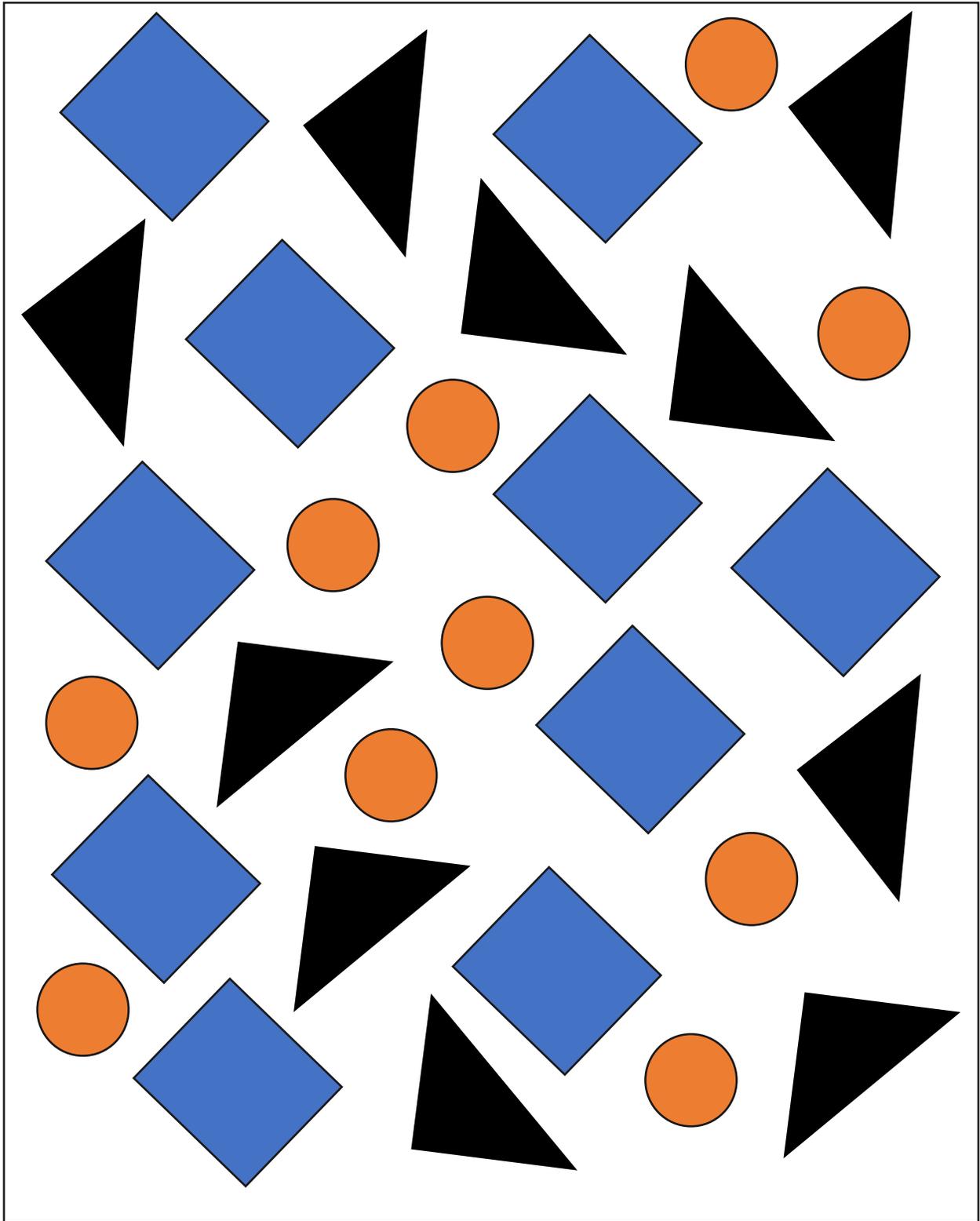
Closure

26. Have the students participate in a review activity called "I Have a Question, I Have an Answer." Divide the class—evenly, if possible—and distribute cards from *Handout 6-5: Closure Activity* so that one-half of the class gets an "I Have a Question!" card and the other half gets an "I Have an Answer!" card. NOTE: If not all questions and answers are used, be sure that each question handed out has a corresponding answer.
27. Explain that the students who have the question cards will each read their question aloud. The students who have the answers need to listen carefully so that they can both determine if theirs is the one that answers the question and then read the answer aloud. An extra uncut copy of Handout 6-5 can be used as a key for the teacher.
28. Continue the activity until all questions have been asked and answered. For extra review, you can reverse the roles for the students and switch some of the used questions and answers with any unused ones.

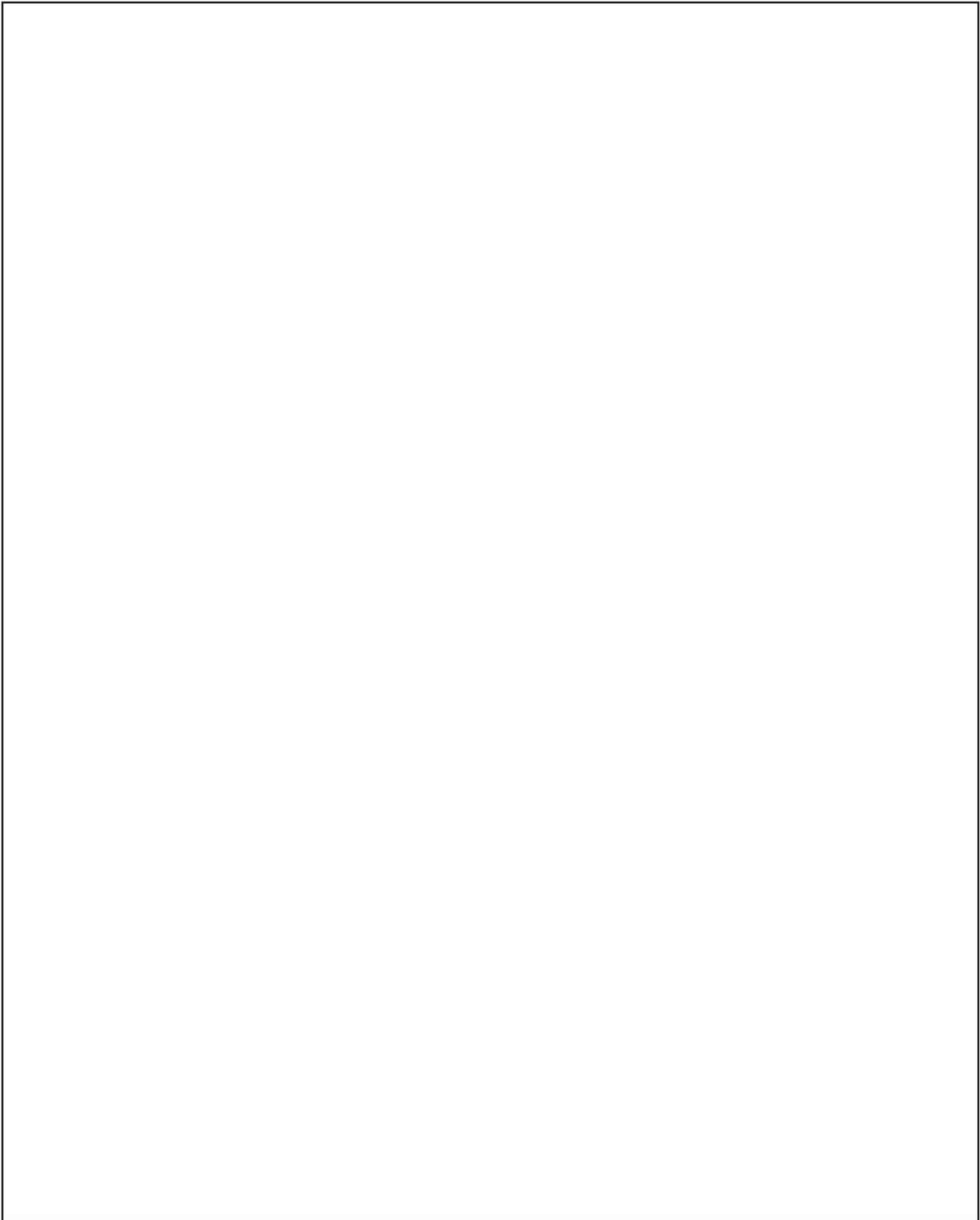
Assessment

29. Have students research and write a few paragraphs about the waste management efforts of a company of their choice. Their research should specifically highlight what the company produces, how it produces it, and what its savings are from innovating more-efficient forms of production.

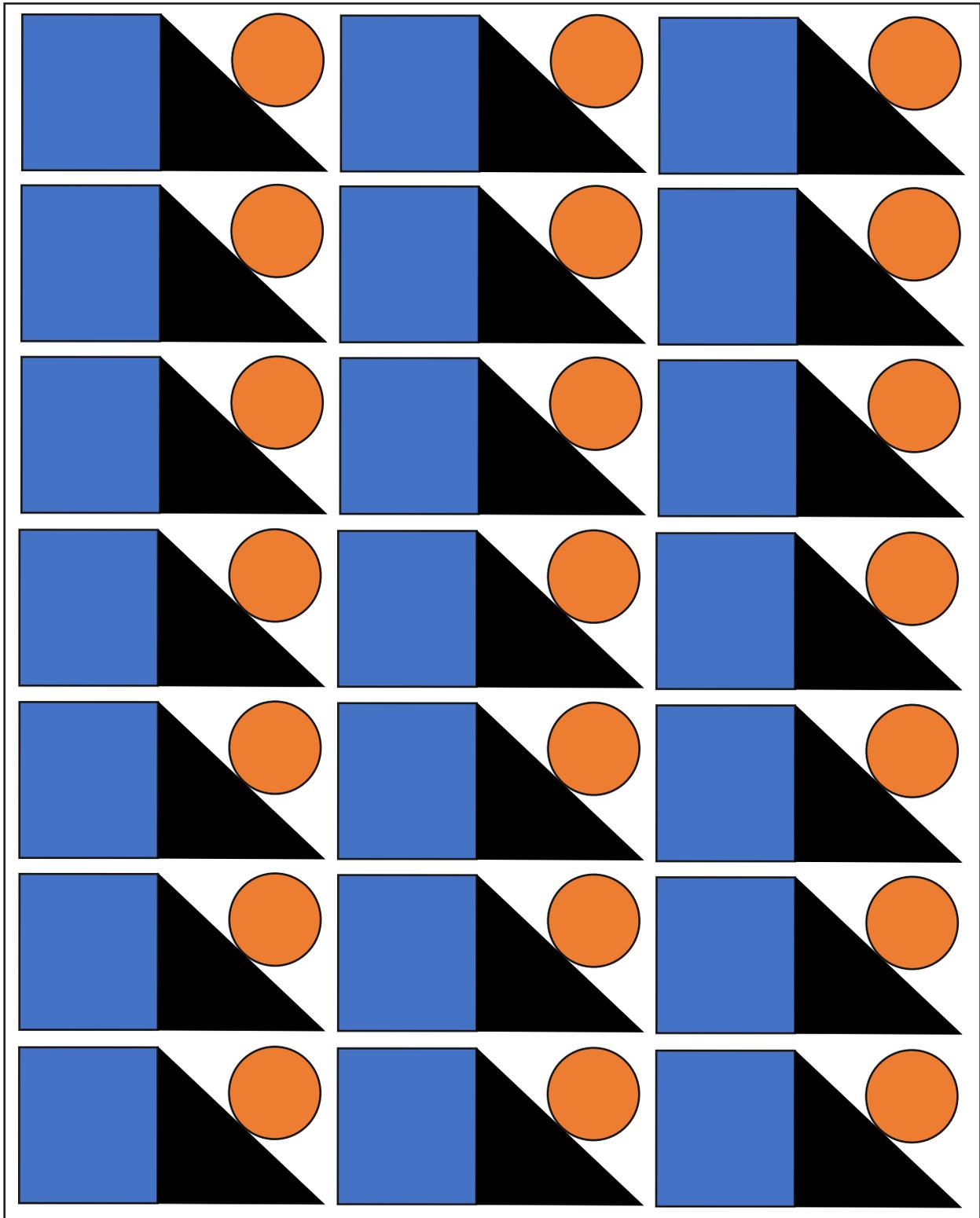
Handout 6-1: Round 1—Shapes



Handout 6-2: Round 2—Blank



Handout 6-2: Round 2—Sample Answers



Handout 6-3: Calculations Worksheet

Round 1

Wood sheet = \$2.50
Labor per set (circle, triangle, square) = \$1
Waste disposal fee per gram = \$0.50
Other resources (capital, land) = \$1
Each set sells for \$4

- A. Total sets produced per sheet _____
- B. Total sets produced x Cost of labor per set \$ _____
- C. Waste disposal (Grams x Cost) Grams = _____ \$ _____
- D. Cost of wood sheet and other resources \$ _____
- E. Total cost (B + C + D) \$ _____
- F. Total sets x Sale price = **Revenue** \$ _____
- G. Revenue (F) – Total cost (E) = **Profit** \$ _____

Round 2

Wood sheet = \$3
Labor per set (circle, triangle, square) = \$1
Waste disposal fee per gram = \$0.55
Other resources (capital, land) = \$1
Each set sells for \$4

- A. Total sets produced per sheet _____
- B. Total sets produced x Cost of labor per set \$ _____
- C. Waste disposal (Grams x Cost) Grams = _____ \$ _____
- D. Cost of wood sheet and other resources \$ _____
- E. Total cost (B + C + D) \$ _____
- F. Total sets x Sale price = **Revenue** \$ _____
- G. Revenue (F) – Total cost (E) = **Profit** \$ _____

Total Profit Round 1: \$ _____

Total Profit Round 2: \$ _____

Total Difference: \$ _____

Handout 6-3: Calculations Worksheet—Sample Answers

Round 1

Wood sheet = \$2.50
Labor per set (circle, triangle, square) = \$1
Waste disposal fee per gram = \$0.50
Other resources (capital, land) = \$1
Each set sells for \$4

- A. Total sets produced per sheet 10
- B. Total sets produced x Cost of labor per set $10 \times \$1 = \10 (Labor cost)
- C. Waste disposal (Grams x Cost) Grams = **6** $\$0.50 \times 6 = \3 (Disposal cost)
- D. Cost of wood sheet and other resources $\$2.50 + \$1 = \$3.50$ (Other cost)
- E. Total cost (B + C + D) \$16.50
- F. Total sets x Sale price = **Revenue** $10 \times \$4 = \40
- G. Revenue (F) – Total cost (E) = **Profit** $\$40 - \$16.50 = \$23.50$

Round 2

Wood sheet = \$3
Labor per set (circle, triangle, square) = \$1
Waste disposal fee per gram = \$0.55
Other resources (capital, land) = \$1
Each set sells for \$4

- A. Total sets produced per sheet 21
- B. Total sets produced x Cost of labor per set $21 \times \$1 = \21 (Labor cost)
- C. Waste disposal (Grams x Cost) Grams = **4** $\$0.55 \times 4 = \2.20 (Disposal cost)
- D. Cost of wood sheet and other resources $\$3 + \$1 = \$4$ (Other cost)
- E. Total cost (B + C + D) \$27.20
- F. Total sets x Sale price = **Revenue** $21 \times \$4 = \84
- G. Revenue (F) – Total cost (E) = **Profit** $\$84 - \$27.20 = \$56.80$

Total Profit Round 1: \$23.50

Total Profit Round 2: \$56.80

Total Difference: \$33.30

Handout 6-4: Case Study (page 1 of 2)

Less Wasteful Waste

Landfills are not free plots of land where waste is collected and nothing is done with the waste. Waste management is a business of its own with operating costs that need to be paid for, just like any other business. Every company, whether it provides a good or service, has a significant amount of waste that needs to be processed and disposed of safely to minimize harm to the environment. Waste management businesses charge other businesses gate or land tipping fees. These are charges that vary based on the type and amount of waste that is collected, and they are used to cover the costs of waste collection, transportation, and sorting. It is usually measured in tons and ranges from \$20 to slightly above \$100 per ton, depending on where the businesses are located. Hazardous waste disposal fees can be more than 10 times higher.

These fees are a cost that can be decreased, providing businesses with the motivation to innovate more-efficient production methods that result in less waste. These companies look for ways to recycle and reuse their waste in ways that decrease their waste disposal costs, which in turn increases their profits. Collecting materials that can be recycled costs less, and companies use this as an opportunity to innovate other uses for the recycled material. For example, Apple Inc. implemented an active recycling program that saves the company \$1 million per year. In the manufacturing process of all iPhones and Apple watches, recyclable materials are sorted within the production line itself. The company is putting forth many efforts and innovations to have zero waste from the development, production, and selling stages in its production process.

Capturing waste—redirecting waste to be used in other parts of the production process within a company's own manufacturing, or selling it to other manufacturers as a resource—has proved for many companies a much more profitable venture than wasting. With society's increasing use of social media outlets, companies are under a finer lens of the public eye, and this is especially true of their efforts to be greener. Image is everything for companies looking to thrive in a consumer world like ours; when consumers feel good about a company's products, they purchase more. There have been proven negative effects on companies that are not cautious about their production and resource management. For example, Conagra Brands Inc., which makes Reddi-Wip® whipped cream, Hunt's® ketchup, and Orville Redenbacher's® popcorn, has been cited as one of the top 10 companies with the worst sustainability record. The company has paid high pollution fines because their Oregon plant exceeded the limit of nitrate pollution disposal, which can harm freshwater sources. Their reputation, through news outlets and online sources, was tarnished some years ago as a result. This in turn can hurt profits. Being green pays, and some companies are not only following government regulation, but going beyond and creating their own initiatives for profit, public image, and non-depletion of the resources needed to produce their goods.

Handout 6-4: Case Study (page 2 of 2)

Comprehension Questions

1. What are land tipping fees?
2. Explain how Apple Inc. increased recycling in its production process.
3. What are some reasons businesses are increasingly more aware of their waste disposal?
4. Calculate how much a company would have to pay in land tipping fees if a small manufacturer of wooden puzzles has 200 tons of waste and the land tipping fee is \$85 per ton.
5. If the wooden puzzle manufacturer hires you as a consultant to study and provide solutions for greener production methods that could decrease its waste and land tipping fees, what solutions might you suggest?

Handout 6-5: Closure Activity (page 1 of 2)

<p>I Have A Question! What are the factors of production?</p>	<p>I Have An Answer! Land, labor, and capital</p>
<p>I Have A Question! What type of capital is used in the production of vanilla ice cream?</p>	<p>I Have An Answer! Factory, blender, pasteurization machine, processing machine, conveyer belt, cardboard, and electricity</p>
<p>I Have A Question! What is the form of payment for labor?</p>	<p>I Have An Answer! Wages</p>
<p>I Have A Question! Why are goods and services scarce?</p>	<p>I Have An Answer! Because resources are scarce</p>
<p>I Have A Question! What is an example of a resource we get from land?</p>	<p>I Have An Answer! Natural resources such as air, oil, and mineral deposits</p>
<p>I Have A Question! What is the form of payment for land?</p>	<p>I Have An Answer! Rent</p>
<p>I Have A Question! How is revenue calculated?</p>	<p>I Have An Answer! Selling price of a good or service \times the number of units sold</p>
<p>I Have A Question! What is profit?</p>	<p>I Have An Answer! The surplus remaining after total costs are deducted from total revenue</p>

Handout 6-5: Closure Activity (page 2 of 2)

<p>I Have A Question! What is an example of a labor resource?</p>	<p>I Have An Answer! The baker at a grocery store</p>
<p>I Have A Question! Businesses can increase their profitability by doing what with their waste?</p>	<p>I Have An Answer! Businesses can use their resources more efficiently by capturing their waste and reusing it in other goods in the production process.</p>
<p>I Have A Question! What is the form of payment for land?</p>	<p>I Have An Answer! Rent</p>
<p>I Have A Question! Why is capturing waste more profitable than just throwing it away?</p>	<p>I Have An Answer! It results in the manufacturer paying less in land tipping fees, producing less pollution, having a better social image, and earning more profit.</p>
<p>I Have A Question! What is an example of a resource we get from land?</p>	<p>I Have An Answer! Natural resources such as air, oil, and mineral deposits</p>
<p>I Have A Question! Can you name some companies that are making sustainability profitable?</p>	<p>I Have An Answer! Tesla, Chipotle, Toyota, GE's Ecomagination, and Patagonia</p>
<p>I Have A Question! How have companies that looked beyond profit and increased their sustainability efforts performed since 2011?</p>	<p>I Have An Answer! Companies that have increased sustainability efforts have outperformed the competition by 11.7 percent.</p>
<p>I Have A Question! What are variable costs?</p>	<p>I Have An Answer! Costs of those factors of production that vary as production changes</p>

Standards and Benchmarks

Voluntary National Content Standards in Economics

Standard 1: Scarcity

Productive resources are limited. Therefore, people cannot have all the goods and services they want; as a result, they must choose some things and give up others.

- **Benchmark: Grade 12**

1. Choices made by individuals, firms, or government officials are constrained by the resources to which they have access.

Standard 4: Incentives

People usually respond predictably to positive and negative incentives.

- **Benchmarks: Grade 12**

1. Acting as consumers, producers, workers, savers, investors, and citizens, people respond to incentives in order to allocate their scarce resources in ways that provide them the most possible net benefit.
2. Decision making in small and large firms, labor unions, educational institutions and not-for-profit organizations has different goals and faces different rules and constraints. These goals, rules, and constraints influence the benefits and costs of those who work with or for those organizations, and therefore their behavior.

Standard 8: Role of Prices

Prices send signals and provide incentives to buyers and sellers. When supply or demand changes, market prices adjust, affecting incentives.

- **Benchmark: Grade 12**

2. Supply of a product changes when there are changes in either the prices of the productive resources used to make the product, technology used to make the product, the profit opportunities available to producers from selling other products, or the number of sellers in a market.

Notes

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