Ms. Virginia's Cookie Factory

Topic
Resource use

Key Question
How can we use resources to manufacture cookies while managing our raw materials and reducing waste?

Learning Goals
Students will:
- understand that manufacturing processes use natural resources to produce a product;
- understand that manufacturing products also produces wastes, and in many cases, wastes can be reduced to help prevent pollution; and
- learn that wastes produced by industry are handled differently and are not just "thrown away"—they can be recycled, reprocessed, or disposed of using environmentally-approved methods to prevent pollution.

Guiding Document
Project 2061 Benchmarks
- *The benefits of the earth's resources—such as fresh water, air, soil, and trees—can be reduced by using them wastefully or by deliberately or inadvertently destroying them. The atmosphere and the oceans have a limited capacity to absorb wastes and recycle materials naturally. Cleaning up polluted air, water, or soil or restoring depleted soil, forests, or fishing grounds can be very difficult and costly.*
- *Manufacturing usually involves a series of steps, such as designing a product, obtaining and preparing raw materials, processing the materials mechanically or chemically, and assembling, testing, inspecting, and packaging. The sequence of these steps is also often important.*

Math
Measurement
- linear
- mass

Number and operations

Science
Environmental science
- resource use
- pollution
- waste

Technology
Manufacturing

Integrated Processes
Observing
Comparing and contrasting
Recording

Materials
For each group:
- rolling pin (see *Management 2)*
- cookie cutters
- cleaning supplies (see *Management 4)*
- wax paper
- sandwich-size plastic bags
- 3 containers of children's play clay (red, white, and blue)
- metric ruler
- markers
- construction paper
- role cards
- play money ($500)
- student pages

For the class:
- newspaper for floor
- balance
- gram masses

Optional:
- 6 plastic containers labeled "flammable" or "hazardous"
- 6 "handle with caution" lids

Background Information
Industries use natural resources to manufacture goods. Different kinds of wastes (pollution) are generated as a by-product of manufacturing. All industries attempt to reduce waste in order to increase profits and to reduce the amount of waste produced. Any waste produced costs money—both in lost resources and in cost for disposal. Preventing waste prevents pollution and makes good economic sense for business.

Management
1. Each group will need three colors of children's play clay (e.g., Play-Doh™). The cookie cutters should be identical from group to group so that all teams can make cookies to the same specifications. If possible, get more than one shape.
2. Smooth-sided drink bottles filled with water can be used as rolling pins.
3. Wax paper can be used to provide students with a surface on which to roll out the play clay. It

is recommended that you put newspaper on the floor under the work stations to prevent any clay from getting on the carpet or tile.

4. Provide each group with some basic cleaning supplies to clean their cookie cutters, rolling pins, and work areas. These could be damp sponges, paper towels, baby wipes, etc. Have extra supplies on hand for groups to buy if they run out their initial supply.
5. Each team should begin with $500 of play money. This will allow them to buy all of the necessary materials. The start-up kit, which costs $300, needs to include two cans of play clay, one rolling pin, two cookie cutters, cleaning supplies, three plastic bags, and wax paper (to be used as a work surface). The third can of play clay, which also must be purchased, costs $100.
6. Copy and cut apart a set of role cards for each group before beginning the activity. Determine which role cards you want the groups to use. The technician's assistant is only used when the class cannot be divided evenly into groups of five. Not all groups will have a technician's assistant. There is also an optional Department of Environmental Quality (DEQ) Inspector.
7. The colors of play clay represent specific things. Red clay is a raw material that cannot be reused (dough you can roll only once) or must be disposed of carefully (e.g., flammable or hazardous). Blue and white play clay can be recycled under certain conditions (e.g., fed to animals). If the clay is mixed, then the raw materials are contaminated and customers will not buy the product. Play clay must be recycled according to "approved methods" listed in the recycling rules. Any red play clay cannot be recycled and must be removed at the company's cost. Pure blue and white play clay can be recycled and should be sorted and stored correctly; it is worth money to the company. Any blue or white play clay that has been rolled out or otherwise worked with cannot be reused in the manufacturing process and must be recycled immediately. (Option: Blue or white could be specified as reusable in the manufacturing process to demonstrate the difference in waste generation.)
8. You (or another adult) will play the role of the customer after the materials are handed out and instructions are explained. The customer's role is to place orders, create pressure, demand quality, and generally harass the teams with the goal of creating an atmosphere of good-natured competition and chaos. The customer circulates to each team and places an order with the "big boss." After the teams have begun working, the customer begins requesting samples from each team and inspects their quality. While inspecting each team's product, the customer mentions how well their competition is performing, and reminds them how important the job is to their company.

Procedure

1. Divide the class into groups of five or six. Give each group $500 of play money and the role cards. Assign (or allow students to choose) roles.
2. Give groups markers and construction paper. Have them choose names for their businesses, design logos, and make company signs for their work tables.
3. Explain that the teams are in competition with each other to produce cookies desired by a customer. The cookies must be made to exacting standards or the customer will not buy them.
4. Distribute a copy of the student pages to each group. Describe what the colors of play clay represent and the rules that govern their use and disposal (see *Management 7)*. Have students fill in the blanks on the first student page with the appropriate colors.
5. Instruct the big boss from each team to come and purchase the necessary supplies. Each group must purchase a start-up kit ($300) and one extra can of play clay ($100). They may choose to purchase extra cleaning supplies ($10), or they can wait and buy them later if they need them. Give each group a few minutes to set up their equipment and supplies. Let them decide how to do this.
6. Give the teams the first order to make 10 blue stars (or other shape) that are five millimeters thick. The stars should be an even thickness, smooth on both sides and contain no mixed colors. The stars must be cookie-cutter made; no hand-molded stars are allowed.
7. When the first team is near completion, give the order to make 10 white stars with the same specifications.
8. When all teams have started on this order, inform teams that you need an order of three red hearts that are 10 mm thick before you need the white stars. (Note: this change is designed to cause confusion and dismay among the teams as they must stop one task, change the play clay, clean their equipment, and start another order.)
9. Once the teams have finished the red hearts, they can finish the white stars.
10. Go around to inspect and "buy" all pieces that meet specifications once a team has finished all three orders. If some pieces do not meet the specifications, the team may work until the last team completes their third order. Once the last team has completed all the orders, all work must stop and all stations must be cleaned up.

11. After all work has stopped, play the part of the recycling company and "buy" the uncontaminated, non-toxic materials at a specified price per gram ($0.50/gram). Have groups use the balance to determine how much money they should receive for their play clay. Contaminated play clay (mixed or red) must be hauled off by a waste management company. The factory pays to have it removed at a cost of $10.00/gram.
12. Have groups use the balance sheet to determine their ending balances based on their costs, sales, recycling rebate, and remaining inventory.

Connecting Learning

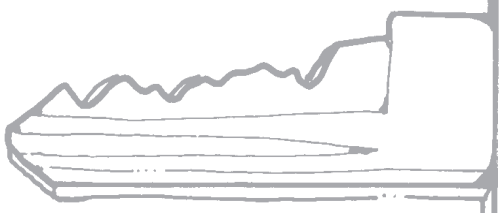
1. How did your team work together? Was everyone able to fulfill the responsibilities of their roles?
2. What problems did your team experience as you tried to meet the orders? How did you solve these problems?
3. What teams produced the least waste? Why might this be the case?
4. How could you organize the materials or change the process to get better results?
5. How would employee training, new equipment, and/or new play clay help?
6. How was this experience like something you would find in the real world? How was it different?
7. What are you wondering now?

Extension

Have the teams evaluate their "bottom lines" and discuss how they can increase their profits and decrease the waste generated. Ask the "inspectors" for their recommendations. Which teams generated the most and least waste? Discuss how communications can be improved and how roles and processes should change to facilitate pollution prevention. Have the groups replay the activity with a "waste manager" on staff whose role is to remind other team members about contamination problems and correct storage and recycling methods. Other waste minimization ideas, such as carefully estimating the amount of raw materials needed, can be employed.

Used with permission from *Pollution Solutions;* activity developed by the Virginia Department of Environmental Quality, based on an EPS pollution prevention training activity.

Ms. Virginia's Cookie factory



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Role Cards

Big Boss: You are in charge of the whole team's operation. You receive information from the customer and pass information to other team members through Quality Control and Production Managers only. You do not talk directly with any other team member. You keep your back to the team most of the time and think everything is late. You only care about the finished product and usually forget about the paperwork.

Production Manager: You are responsible for all deadlines. You need to make sure that the team members are always working and the product is getting made. You check out progress every two to three minutes only and think that most of the technicians aren't working fast enough.

Quality Control Manager: You're the only guardian of the company's good name. It is your responsibility to make sure the product is the best it can be. If the product is not good enough for you, then it is not good enough. You're afraid that the technicians are trying to slip inferior products past you.

Technicians (2 per team): You are the workers. You do what the production manager says and make sure that the product meets the approval of the quality control person. Only you understand how the equipment works. You think you are underpaid and overworked and don't like to be pushed around.

Technician's Assistant: You assist the technicians however they ask. You usually end up with all the dirty jobs.

DEQ Inspector: (Optional) You know that every facility has something to hide and your job is to find it. The paper work is never filled out right; their records are never where they're supposed to be, and all the labels are upside down. You observe the process and recommend how to generate less waste.

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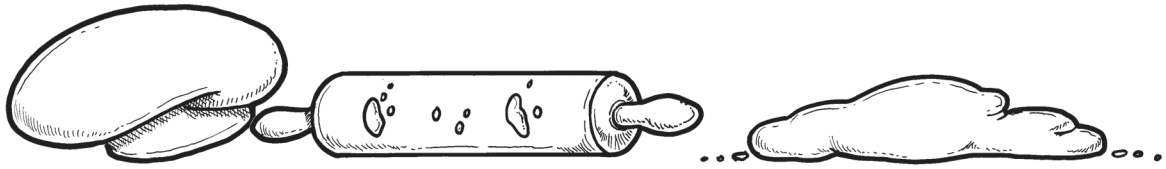
Waste Management and Recycling Rules

1. _____-colored play clay is not recyclable; you must pay to have it removed.
   Cost of removal: $10/gram

2. _____ and _____-colored play clay are recyclable and should be sorted and stored in plastic bags. Any play clay that has been rolled or otherwise worked with, CANNOT be reused in the manufacturing process and must be recycled immediately.
   Recycling rebate: $0.50/gram).

3. The team generating the LEAST amount of waste (by weight) earns a bonus of $200.00.

Reminder: If the final products (cookies) are multi-colored (the raw material of play clay is mixed together), then they are contaminated and the customer will not purchase the parts. These are high quality cookies you are making!



Manufacturing Specifications & Price List:

Thin cookies (any shape)
5 mm thick, consistent thickness, smooth top and bottom
$10 each

Thick cookies (any shape)
10 mm thick, consistent thickness, smooth top and bottom
$25 each

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Customer Order Form

Thin Cookies

Shape	Color	Quantity		Cost
			x $10	
			x $10	
			x $10	
			x $10	
			Sub-total	

Thick Cookies

Shape	Color	Quantity		Cost
			x $10	
			x $10	
			x $10	
			x $10	
			Sub-total	

Order Total

Thin cookie sub-total	
Thick cookie sub-total	
Order total	

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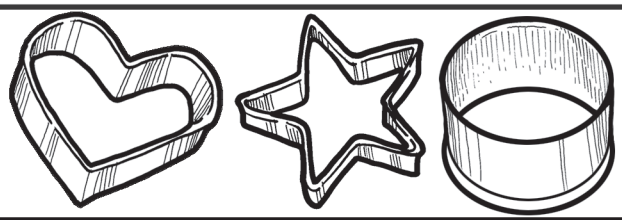
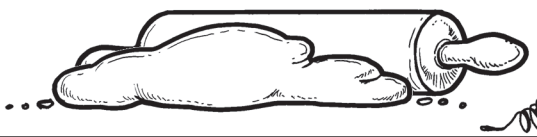
Balance Sheet

Profit or Loss Statement for _____
(company name)

		Debit (-)	Credit (+)
	Beginning Balance (money you started with)		
Costs	Start-up kit ($300): play clay, 2 cans rolling pin cookie cutters, 2 ruler plastic bags, 3 cleaning supplies wax paper (work surface)		
	Each additional can of play clay ($100):		
	Extra cleaning supplies ($10):		
	Subtotal		
Income	Gross Sales (amount of money you made)		
	Recycling Rebate ($0.50/gram received for used play clay)		
	Inventory (play clay not used—$1.00/gram)		
	Ending Balance (net worth)		





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