Math and Science Gumbo Teacher Guide

www.pbs4549.org/gumbo

Contents

Credits

Project Manager and Instructional Designer

Dave Benson, Educational Technology Consultant, PBS 45 & 49

Content Experts

Terrie Baumgartner, Tuslaw Local Schools
Linda Vratkovich, Campbell City Schools
Kerri Strobelt, Hudson City Schools
Jacqueline Dukes, Hudson City Schools
Ken Bogucki, The College of Wooster
Chuck Wagers, The College of Wooster
Marjorie Shamp, The College of Wooster

Producer

Duilio Mariola, Producer/Director, PBS 45 & 49

Graphic Design

Paula Kritz, Graphic Designer, PBS 45 & 49

Editor

Diane Steinert, Writer/Editor, PBS 45 & 49

Script

Larry Chance, Last Chance Productions

Produced By

PBS 45 & 49 (WNEO/WEAO, Youngstown/Akron, OH)

Made possible by the Ohio state legislature through a grant from Ohio SchoolNet.

Introduction and Description

Weights, measures, cooking times and temps, physical and chemical changes ... you name it and the Kitchen Mathematician will beat, mix, blanche, toast, boil and fricassee food to explore the math and science that goes into cooking.

Math and Science Gumbo takes the unique approach of using food and cooking to teach many principles of math and science. The series focuses on math concepts like unit pricing, fractions, estimation, units of measurement, area and so on. On the science side, the series looks at the concepts of physical and chemical change, preservation, refrigeration, enzymes, microorganisms and gas laws. **Math and Science Gumbo** is tied to Ohio's Academic Content Standards.

Lesson Plans

1. **Grocery Store:** Many good recipes require the cook to purchases items at the grocery store. Smart shoppers understand unit pricing, estimation and computation, economics, multiples and the various methods used for paying for purchases.
    a. Visiting the Virtual Grocery Store
    b. Comparing Generic Brands to National Brands
    c. Making Change
    d. Coupons
    e. Credit Card Enrichment

2. **Food Preservation:** Preserving food to prevent spoilage involves chemical and physical changes. It also requires knowledge of units of measurement, volume and food safety.
    a. Mr. or Mrs. Gallonhead
    b. Fruit Juice Popsicles
    c. Sun Pickles
    d. Fruit Leathers

3. **Bake Shop:** There's nothing like the aroma of fresh, hot baked goods, right out of the oven. In this section, students will learn about units of measurement, fractions and the physical and chemical changes of baking.
    a. Doubling and Tripling Recipes
    b. Pumpkin Problem
    c. Chemical and Physical Changes
    d. Make It Hot! Hot! Hot! (Temperature Conversion)

4. **Restaurant:** Restaurants and school cafeterias buy and prepare large quantities of food every day. How do they know what to buy and prepare when they don't know exactly how many people are coming to dinner?
    a. Overhead and Profit
    b. The Cost of Running a Restaurant
    c. Root Beer Floats: States of Matter
    d. Homemade Ice Cream Challenge

5. **Pizza Shop:** Hot, fresh pizzas are more than just delicious! Their different shapes are perfect for learning about fractions, remainders, percentage and area. Plus, a pizza's baking process is the perfect way to learn about elapsed time.
    a. Parts of a Set
    b. Area of a Rectangle and a Square
    c. Equivalent Fractions and Fraction Bars
    d. Data Analysis and Probability
    e. Equivalent Fractions Model

Notes

Math and Science

Gumbo

Grocery Store

www.pbs4549.org/gumbo

Visiting the Virtual Grocery Store

Objectives

- Students will be given a fixed amount of money and specific items to purchase.
- Students will use newspaper grocery inserts and estimation to determine if they have sufficient funds.

Ohio Academic Content Standards

Mathematics

Number, Number Sense and Operations

Benchmark I:
Use a variety of strategies, including proportional reasoning, to estimate, compute, solve and explain solutions to problems involving integers, fractions, decimals and percents.

Indicators:
Grade 5
13. Estimate the results of computations involving whole numbers, fractions and decimals, using a variety of strategies.

Grade 6
13. Estimate reasonable solutions to problem situations involving fractions and decimals.

Mathematics

Measurement

Benchmark B:
Convert units of length, area, volume, mass and time within the same measurement system.

Indicators:
Grade 5
5. Make conversions within the same measurement system while performing computations.

Overview of Lesson

Using estimation, students determine if they can purchase enough of the items in their recipe to make a dinner for 12 guests.

Goal

Students will learn how to plan for purchases.

Materials

- Newspaper inserts
- Paper
- Pencils or pens

Procedure

This lesson can be implemented in different ways to fit your classroom needs.

1. Divide students into groups of three or four.
2. Give each group a list of items to "purchase." The handout on page 11 gives a list of items needed. The recipe makes enough food for six people. The students are to purchase enough food for 12 people.
3. Give each group a grocery store insert from the newspaper.
4. Within a determined amount of time, the groups are to locate the items they need to purchase, estimate the price and write the price on the handouts. They are to total their purchase and determine if they have enough money.

Option: Visiting a virtual grocery store

If newspaper inserts are not available, students may visit an online grocery store.

1. Introduce students to a Web site that allows consumers to shop for groceries (i.e. **www.schnucks.com**). Students fill in their name, password for shopping, address, etc. The students should use a fictional ZIP code so that the site will respond that the address is outside of the delivery area and therefore, the students will be "test driving."
2. Have the students follow the procedure listed above.

Evaluation

Use the students' completed handouts and the rubric for evaluation.

Rubric: Visiting the Virtual Grocery Store

CATEGORY	4	3	2	1
Strategy/ Procedures	Typically uses an efficient and effective strategy to solve the problem(s).	Typically uses an effective strategy to solve the problem(s).	Sometimes uses an effective strategy to solve problems, but does not do it consistently.	Rarely uses an effective strategy to solve problems.
Mathematical Concepts	Explanation shows complete understanding of the mathematical concepts used to solve the problem(s).	Explanation shows substantial understanding of the mathematical concepts used to solve the problem(s).	Explanation shows some understanding of the mathematical concepts needed to solve the problem(s).	Explanation shows very limited understanding of the underlying concepts needed to solve the problem(s) OR is not written.
Mathematical Reasoning	Uses complex and refined mathematical reasoning.	Uses effective mathematical reasoning.	There is some evidence of mathematical reasoning.	There is little evidence of mathematical reasoning.
Neatness, Organization, Grammar and Spelling	The work is presented in a neat, clear, organized fashion that is easy to read.	The work is presented in a neat and organized fashion that is usually easy to read. Grammar and spelling are generally correct.	The work is presented in an organized fashion but may be hard to read at times. There are some grammar and spelling errors.	The work appears sloppy and unorganized. It is hard to know what information goes together. Grammar and spelling are poor.

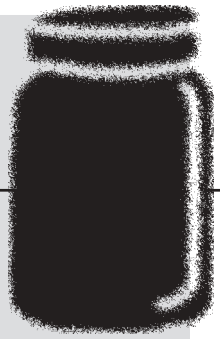
Student Handout

Josh has just graduated from high school and his family wants to have a party. Josh wants to invite eight friends for dinner, along with his brother, mother and father, so he offers to help pay for the dinner. Josh has saved $30. Will he have enough to pay for the food needed to make the recipe below?

Item	**Estimated cost**
2 onions	
1/4 cup butter	
6 pork chops	
2 cups chicken broth	
4 carrots	
3 potatoes	
Total estimated cost	

1. Each group has $30 to spend on groceries.

2. The recipe above is enough for six people. You must purchase enough food for 12 people.



Comparing Generic Brands to National Brands

Objectives

- Students will gather information.
- Students will create a table to compare product prices between generic and national brands.

Overview of Lesson

Collecting prices of store-brand (generic) foods and comparing them against national brands allows students to make logical inferences about product prices in the grocery store.

Goal

Students will learn from a real-life example of cost comparison between generic and national brands.

Ohio Academic Content Standards

Mathematics

Data Analysis and Probability (Grades 3-4)

Benchmark A:
Gather and organize data from surveys and classroom experiments, including data collected over a period of time.

Benchmark B:
Read and interpret tables, charts, graphs (bar, picture, line, line plot) and timelines as sources of information, identify main idea, draw conclusions and make predictions.

Indicators:
Grade 3

1. Collect and organize data from an experiment, such as recording and classifying observations or measurements, in response to a question posed.
5. Match a set of data with a graphical representation of the data.

Grade 4

1. Create a plan for collecting data for a specific purpose
2. Represent and interpret data using tables, bar graphs, line plots and line graphs.

Mathematics

Data Analysis and Probability (Grades 5-6)

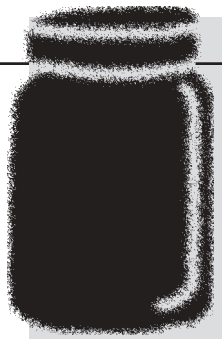
Benchmark B:
Interpret data by looking for patterns and relationships, draw and justify conclusions and answer related questions.

Indicators:
Grade 5

4. Determine appropriate data to be collected to answer questions posed by students or teacher, collect and display data and clearly communicate findings.

Grade 6

6. Make logical inferences of statistical data.



Materials

- Grocery store flyers and/or newspaper circulars, or a list of prices of both generic and national-brand products

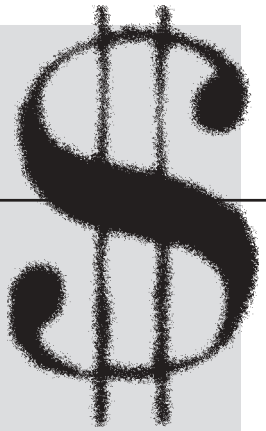
Procedure

1. Using grocery store flyers and newspaper circulars, have students research prices for generic brands and national brands. In lieu of flyers and circulars, teachers may give students the information
2. Have the students calculate the unit price of each item. The unit price, if written as a fraction, always has a denominator of 1.

   Example: $.90 for 9 ounces = .90/9 = .10/1 or a unit price of $.10 for 1 ounce.
3. Students then develop a table to organize the data.
4. Encourage the students to make logical inferences from the data.

Evaluation

Use the data tables developed by the students, plus their lists of inferences.



Making Change

Objectives

- Students will review the values of coins and dollar bills.
- Students will determine what items they would like to buy.
- Students will practice counting change.

Ohio Academic Content Standards

Mathematics

Number, Number Sense and Operations (Grade 3)

Benchmark F:
Count money and make change using both coins and paper bills.

Indicators:
4. Count money and make change using coins and paper bills to 10 dollars.

Overview of Lesson

Using real-life examples, students discover how to make change for coins and paper bills totaling up to $10.

Goal

Students will learn how to make change.

Materials

- Play money
- Grocery store flyers and newspaper circulars

Procedure

1. Review with the students the values of coins and bills in the American monetary system.
2. Divide students into groups of four.
3. Present the following problem: If you spend $3.75 and pay with a $10 bill, how much money will you get in change?
4. Give the students time to work with their play money and discuss this problem with each other.
5. As students work, move through the room and ask them to explain their thinking to you.
6. Pass out grocery store flyers and newspaper circulars to the students and tell them that they have $10 to spend.
7. The students may choose one or several items that total under $10.
8. Have the students figure out how much change they will receive, using whatever method works best for them.
9. The students then count out the change.

Evaluation

Evaluate how the students count out the change, and also how they explain the process that they used to determine the correct change.

Coupons

Objectives

- Students will calculate the amount of money spent on items without using coupons.
- Students will calculate the amount of money saved by using coupons.
- Students will compare the two amounts to see the value of coupon shopping.
- Older children will discover the percentage of money saved by using a coupon.

Ohio Academic Content Standards

Mathematics

Number, Number Sense and Operations (Grades 3-4)

Benchmark K:
Analyze and solve multi-step problems involving addition, subtraction, multiplication and division of whole numbers.

Indicators:
12. Add and subtract whole numbers with and without regrouping.

Mathematics

Mathematical Processes (Grades 3-4)

Benchmark B:
Use an organized approach and appropriate strategies to solve multi-step problems.

Benchmark L:
Use a variety of methods and appropriate tools (mental math, paper and pencil, calculators) for computing with whole numbers.

Overview of Lesson

Students learn how to use coupons to save money on grocery shopping.

Goal

Students will understand how using coupons can help shoppers save money.

Materials

- Grocery store circulars and/or newspaper inserts (or create a grocery list with items and prices)
- Grocery coupons brought from home (or provide coupon amounts to students)

Procedure

1. Discuss what a coupon is and how it works.
2. Divide the students into groups of two. Give each student a circular obtained from a local supermarket (or a newspaper insert, etc.). If coupons are not available, tell the students that they will pretend to have a coupon for 25 cents and that the coupon may be used on canned goods or some other chosen group of items. (Some items may use a double coupon. Designate these items ahead of time).
3. Each group must "buy" seven items (unless the teacher decides to provide a grocery list).
4. First have the groups find the total price of the items without using a coupon. Then have the groups find the price of the items with the coupons.
5. Compare each total bill to see how much money was saved.

Note: As an extension, have older students find the percentage of money saved for each item and the total bill.

Evaluation

Assess the percentage of achievement by determining the accuracy of the student's findings.

Credit Card Enrichment

Objectives

- Students will compute the cost of charging a set amount of dollars.
- Students will understand how credit card debt increases over a period of time.

Ohio Academic Content Standards

Mathematics

Patterns, Functions and Algebra (Grade 5-6)

Benchmark B:
Represent, analyze and generalize a variety of patterns and functions with tables, graphs, words and symbolic rules.

Benchmark J:
Use formulas in problem-solving situations.

Indicators:
Grade 5
5. Model problems with physical materials and visual representations, and use models, graphs and tables to draw conclusions and make predictions.

Grade 6
1. Represent and analyze patterns, rules and functions, using physical materials, tables and graphs.

Mathematics

Data Analysis and Probability (Grade 6)

Benchmark E:
Collect, organize, display and interpret data for a specific purpose or need.

Indicators:
6. Make logical inferences of statistical data.

Overview of Lesson

Students learn about credit cards and the cost of interest associated with their use.

Goal

Students will understand the costs associated with using a credit card.

Materials

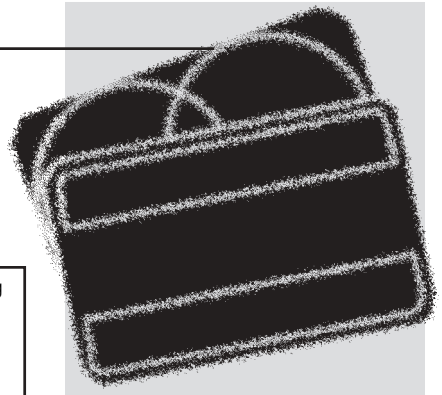
- Student worksheet

Procedure

1. Introduce the concept of credit cards.
2. Discuss credit terminology, including balance, interest, principal, credit and debit.
3. With a beginning balance of $100, have the students compute charges with an annual interest rate of 24 percent (or 2 percent per month):
   Beginning balance = $100
   Monthly interest rate = 2%
   Monthly interest charge = $2 (100 x 2%)
   Ending balance = $102
   Minimum payment due = $12 ($10 principal, $2 interest)

   New beginning balance = $90 ($102 - $12)
   Monthly interest rate = 2%
   Monthly interest charge = $1.80 (90 x 2%)
   Ending balance = $91.80
   Minimum payment due = $10.80 ($9 principal, $1.80 interest)

   Develop a table – continuing the pattern until the balance is below $40.



Evaluation

Determine the percentage of accurate answers on each student's worksheet.

Student Worksheet (With Answers)

Beginning Balance	Interest Rate (monthly)	Interest Charge (beginning balance times 2 percent)	Principal (beginning balance times 10 percent)	Ending Balance (beginning balance plus interest)	Minimum Amount Due (principal plus interest)	New Balance (ending balance minus amount due)
100	2%	100 x .02 = 2	100 x .10 = 10	102	10 + 2 = 12	102 - 12 = 90
90	2%	90 x .02 = 1.80	90 x .10 = 9	91.80	9 + 1.80 = 10.80	91.80 - 10.80 = 81
81	2%	1.62	8.10	82.62	9.72	72.90
72.90	2%	1.46	7.29	80.19	8.75	71.44
71.44	2%	1.43	7.14	72.87	8.57	64.30
64.30	2%	1.29	6.43	65.59	7.72	57.87
57.87	2%	1.16	5.79	59.03	6.95	52.08
52.08	2%	1.04	5.21	53.12	6.25	46.87
46.87	2%	0.94	4.69	47.81	5.63	42.18
42.18	2%	0.84	4.22	43.02	5.06	37.96
37.96						

Credit: Money from a bank or other lending institution that is available for someone to borrow.

Debit: The payment subtracted from the balance of a loan.

Balance: The remainder of a loan after a payment has been made. The difference between the totals of the credit and debit sides of an account.

Principal: The original amount of a debt (loan) on which the interest is calculated.

Interest: A fixed charge for borrowing money; usually a percentage of the amount borrowed.

Credit Card Enrichment Student Worksheet

Beginning Balance	**Interest Rate**	**Interest Charge** (beginning balance times 2 percent)	**Principal** (beginning balance times 10 percent)	**Ending Balance** (beginning balance plus interest)	**Amount Due** (principal plus interest)	**New Balance** (ending balance minus amount due)
$100	2% (monthly)	$100 x .02 = $2	$100 x .10 = $10	$102	$10 + $2 = $12	$102 - $12 = $90
$90	2% (monthly)	$90 x .02 = $1.80	$90 x .10 = $9	$91.80	$9 + $1.80 = $10.80	$91.80 - $10.80 = $81
$81	2% (monthly)					

Credit: Money from a bank or other lending institution that is available for someone to borrow.

Debit: The payment subtracted from the balance of a loan.

Balance: The remainder of a loan after a payment has been made. The difference between the totals of the credit and debit sides of an account.

Principal: The original amount of a debt (loan) on which the interest is calculated.

Interest: A fixed charge for borrowing money; usually a percentage of the amount borrowed.

Credit

Credit is defined as money available for a client to borrow. Consumers use credit cards in place of money to borrow money from a bank or credit card company. Banks and credit card companies allow the consumer to pay off the credit at the end of the month, or to make smaller payments month to month.

To make money on credit, banks and credit card companies will charge interest on the money borrowed on credit. Interest is defined as a fixed charge for borrowing money; it is usually a percentage of the amount borrowed.

Estimation

Estimation is when one judges the approximate value, size or worth of something. If we are estimating values, there are generally two approaches that are used:

1. **Rounding:** A rounded number has about the same value as the number you start with, but it is less exact.

   Here is the general rule for rounding:

   - If the number you are rounding is followed by 5, 6, 7, 8 or 9, round the number up. Example: 38 rounded to the nearest 10 is 40.
   - If the number you are rounding is followed by 0, 1, 2, 3 or 4, round the number down. Example: 33 rounded to the nearest 10 is 30.

2. **Truncating or Front End Rounding – Truncate** means to shorten or cut off. A number that is truncated has all the numbers changed to 0 after the number you are rounding. For example, if you are truncating to the tens place, 57 = 50 and 429 = 420.

   The grocery store is a great example of a place where math is real and estimation skills are important. Did you ever have $10 and need a few things at the store? How do you know when you've bought everything you can afford? How do you figure the tip in a restaurant? By using estimation, of course.

   Some things you might do to improve estimation skills include:

   - Have students estimate how much milk they drink in a week and figure out how many gallons they would have to buy.
   - Have a variety of items and a scale available. Have students estimate the weight of the items and then weigh them to find the actual weight. This can then be graphed into a scatter plot.
   - Have the students examine a variety of items that have the price tags hidden. Let them estimate the actual cost.
   - Using catalogs, have each student cut out product pictures and glue them to a piece of paper. They can keep a list of each product's price on a separate piece of paper. Then have them exchange papers and estimate the costs of the items on the list. They could then compare this to the actual costs.
   - Bring in a shopping bag full of groceries. Let the students lift it and estimate the weight of the bag.

   Estimating time is not as easily accomplished. Tell the students to put their heads down and lift them when they think one minute is over. Write the exact time that they started on the board. They can then write down the time they estimated as being one minute.

Money

One of the real-world skills students need to learn is the ability to understand and use money. They need to understand that money is a medium of exchange and has a variety of forms. The most common way to think about money is currency – bills and change. Other forms of money include checks, credit cards, check cards, online banking, etc.

In order to earn money, people need to work. They open their own business or they work for someone else and bring home a paycheck. You might earn money by mowing lawns or helping around the house. People don't get to keep all of the money they earn. They must pay taxes, insurance and other items before they're able to spend money on the things they want.

A Short History About Money

Before money was invented and people wanted or needed something, they would barter (trade). Coins were first used in 1000 B.C. in a country named Lydia. China was the first country to use paper bills for money. The North American Indians used wampum (strings of beads made with clam shells). The people in the United States first decided to make their own currency when they needed money to pay for the Revolutionary War. Before the mid-1800s each dollar was worth a certain amount of gold or silver. Banks printed all the money. There were more than 10,000 different types of dollars that were printed. These bills (notes) were made in various sizes, colors and designs. From a Web site by Collette McGrew: **www.angelfire.com/il2/colettemcgrew/studentsectionp3.htm.**

Some Interesting Money Facts

- The largest bill in circulation today is $100.
- All paper bills and coins are made at the Bureau of Printing and Engraving in Washington, D.C., and Fort Worth, Texas.
- Our coins are minted in four places: Philadelphia, Pa., Denver, Colo., San Francisco, Calif., and West Point, N.Y.
- The first $1 notes (called United States notes or legal tenders) were issued by the federal government in 1862 and featured a portrait of Secretary of the Treasury Salmon P. Chase.
- In 1955, the government mandated that all currency include the words "In God We Trust."
- The life span of a $1 bill is 22 months.
- The Bureau of Engraving and Printing produces 37 million notes a day with a face value of approximately $696 million.
- A stack of currency one mile high would contain over 14½ million notes.
- The approximate weight of a currency note, regardless of denomination, is one gram.
- If you had 10 billion $1 bills and spent one every second of every day, it would require 317 years for you to go broke.
- Currency paper is composed of 25 percent linen and 75 percent cotton.
- For more money facts, go to **www.moneyfactory.com/document.cfm/18/106.**

Related Books and Materials

- *Alexander Who Used to Be Rich Last Sunday,* by Judith Viorst
- *Arthur's Funny Money,* by Lillian Hoban
- *The Berenstain Bear's Trouble With Money,* by Jan and Stan Berenstain
- *The Cobbler's Song,* by Marcia Sewall
- **F***our Dollars and Fifty Cents,* by Eric A. Kimmel

- *The Go-Around Dollar*, by Barbara Johnston
- *Kermit the Hermit*, by Bill Peet
- *If You Made a Million*, by David M. Schwartz
- *Lemonade for Sale*, by Stuart J. Murphy
- *Make Four Million Dollars by Next Thursday*, by Stephen Manes
- *Max's Money*, by Teddy Slater
- *Millions*, by Frank Cottrell Boyce
- *Money*, by Jennifer Waters
- *A Money Adventure*, by Neale S. Godfrey
- *Money, Money, Money*, by Ruth Belov Gross
- *The Money Story* (multimedia guide teacher guide produced by the U.S. Mint and Bureau of Engraving and Printing)
- *Why Money Was Invented*, by Neale S. Godfrey
- *A New Coat for Anna*, by Harriet Ziefert
- *Noom and Raj Start a Business: The ABCs of Money*, by Moonjar
- The poem "Smart" in *Where the Sidewalk Ends*, by Shel Silverstein
- *Stacey and the Mystery Money*, by Ann Martin

Unit Pricing — Being a Wise Shopper

Listed below are ways that you can become a wise shopper:

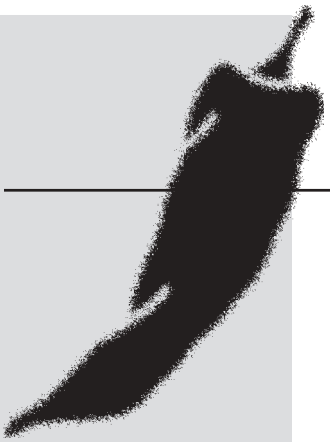
- Compare the price per unit
- Compare brands
- Check sales
- Read labels
- Check weight
- Buy in bulk
- Shop closer, less often
- Use coupons
- Shop at discount stores

But are all of them true? Often buying in bulk (or buying big boxes) saves you money, but does it always? The best way is to determine and compare the **unit price**. Unit means "one," so the unit price is what one of an item you are purchasing costs. For example, a dozen (12) cookies cost $3.60. The unit price would be $3.60/12 or .30/1. Therefore, the unit price or the price for each cookie is 30¢.

Sometimes you need to compare prices. A big box of cereal (24 ounces) costs $2.48. A smaller box (12 ounces) costs $1.75. Which is the better buy?

Big box $\frac{2.48}{24\text{ oz}} = \frac{.103}{1} = .10$ per ounce

Small box $\frac{1.75}{12\text{ oz}} = \frac{.145}{1} = .14\frac{1}{2}$ per ounce



Notes

Math and Science

Gumbo

Food Preservation

www.pbs4549.org/gumbo

Mr. or Mrs. Gallonhead

Objectives

- Students will follow directions from teacher.
- Students will make a diagram illustrating how many quarts, pints, cups and ounces are in a gallon.
- Students will learn that different combinations of liquid measures can be used to create a gallon, quart, pint and cup.

Overview of Lesson

This lesson uses a visual method to teach students about standard liquid measurements.

Goal

Students will understand gallons, quarts, pints, cups and ounces.

Ohio Academic Content Standards

Mathematics

Measurement (Grade 3-4)

Benchmark C:
Develop common referents for units of measure for length, weight, volume (capacity) and time to make comparisons and estimates.

Indicators:
Grade 3

2. Establish personal or common referents to include additional units; e.g., a gallon container of milk; a postage stamp is about a square inch.

Grade 4

1. Relate the number of units to the size of the units used to measure an object; e.g., compare the number of cups to fill a pitcher to the number of quarts to fill the same pitcher.

Mathematics

Measurement (Grade 5)

Benchmark B:
Convert units of length, area, volume, mass and time within the same measurement system.

Indicators:

5. Make conversions within the same measurement system while performing computations.

Materials

- Student worksheet (included) or blank paper
- Samples of gallon, quart, pint and cup containers

Procedure

1. Hand out the Mr. or Mrs. Gallonhead worksheet, or draw a large letter "G" (representing the word "gallon") on a blank sheet of paper.
2. Show the class a gallon-sized container.
3. Have the students divide the space inside the letter "G" into four equal sections and write the letter "Q" (representing a quart) as largely as possible inside each section.
4. Show the class a quart-sized container.
5. Have the students divide the space inside each letter "Q" into two equal sections and write the letter "P" (representing a pint) as largely as possible inside each section.

6. Show the class a pint-sized container.
7. Have the students divide the space inside each letter "P" into two equal sections and write the letter "C" (representing a cup) as largely as possible in each section.
8. Show the class a cup-sized container.
9. Have the students draw a picture of a person inside one of the cup sections and body and then write "I eight a cup of pudding."
10. Inform the class that "eight" is spelled incorrectly because eight is the number of ounces in one cup.
11. Discuss the various measurements in terms of their equivalents (gallon is the largest measure shown, four quarts equal one gallon, two pints equal a quart, etc.).
12. Next ask the students, "If we want to fill this gallon container and we only have one quart container, how many quarts would we need?" Use the various containers to give other examples.
13. After you are comfortable that the students have grasped the concept, have them try the following equivalency game.

Equivalency Game

1. Try to write three equivalencies that you think no one else will try. They must only be true about measures in one gallon. Subsequent rounds can involve more than one gallon, if so desired.

   Examples:

   2 quarts + 2 pints + 4 cups = 1 gallon
   8 cups + 2 pints + 32 ounces = 1 gallon
   3 pints + 6 cups + 1 quart = 1 gallon

2. Take turns reading one of your answers. If anybody else has the same answer, cross it out. See if you can come up with one that nobody else has.

Mr. or Mrs. Gallonhead Worksheet

Fruit Juice Popsicles

Objectives

- Students will weigh juice or other liquid.
- Students will freeze juice or other liquid. Then they will re-weigh and compare properties and weight.
- Students will discuss what physical change has taken place.

Overview of Lesson

Students learn about the physical and chemical changes that take place when juice is frozen.

Goal

Students will understand the chemical and physical changes of the freezing process.

Ohio Academic Content Standards

Science

Physical Science (Grade 6)

Benchmark A:
Relate uses, properties and chemical processes to the behavior and/or arrangement of the small particles that compose matter.

Indicator:
3. Describe that in a physical change (e.g., state, shape and size), the chemical properties of a substance remain unchanged.

Science

Physical Science (Grade 4)

Benchmark A:
Compare the characteristics of simple physical and chemical changes.

Indicator:
2. Identify characteristics of a simple physical change (e.g., heating or cooling can change water from one state to another and the change is reversible).

Mathematics

Number, Number Sense and Operations (Grades 5 & 6)

Benchmark D:
Use models and pictures to relate concepts of ratio, proportion and percent.

Indicators:
Grade 5
1. Use models and visual representations to develop the concept of part-to-part and part-to-whole, and the concept of percent as part-to-whole.

Grade 6
4. Describe what it means to find a specific percent of a number using real-life examples.

5. Use models and pictures to relate concepts of ratio, proportion and percent, including percents less than 1 and greater than 100.

9. Give examples of how ratios are used to represent comparison; e.g. part-to-part, part-to-whole, whole-to-part.

Standard

Measurement (Grades 5 – 6)

Benchmark A:
Select appropriate units to measure angles, circumference, surface, area, mass and volume, using: a) U.S. customary units; e.g., degrees, square feet, pounds and other units as appropriate; b) metric units; e.g., square meters, kilograms and other units as appropriate.

Benchmark B:
Convert units of length, area, volume, mass and time within the same measurement system.

Indicator:
Grade 5
5. Make conversions within the same measurement system while performing computations.

Materials

- Fruit juice
- Ice cube trays or similar containers
- Accurate scales
- Popsicle sticks or sucker sticks (optional)
- Disposable plastic food for sanitary purposes

Procedure

1. Wash the ice cube trays.
2. Have the students weigh the ice cube trays and popsicle sticks separately.
3. Pour juice into the ice cube trays and have the students weigh them again. Remind them to subtract the weight of the ice cube trays.
4. Freeze the juice until it is half-set and then put sticks into each cube, if desired. Continue freezing until the juice is completely frozen.
5. When completely frozen, have the students weigh the trays again. Remind them to subtract the weight of the ice cube trays and popsicle sticks for final results.
6. Once they are finished, they can eat the popsicles!
7. Have students write out the process they used, and what they discovered.

Note: If the ice cube trays are too big to weigh on the scales, use a separate container to weigh the juice. Weigh the container first then weigh the container with the juice. Remember to subtract the weight of the container from the results to get the weight of the juice.

Evaluation

Evaluate students' performance using the Fruit Juice Popsicles rubric.

Rubric: Fruit Juice Popsicles

CATEGORY	4	3	2	1
Strategy/ Procedures	Typically uses an efficient and effective strategy to solve the problem(s).	Typically uses an effective strategy to solve the problem(s).	Sometimes uses an effective strategy to solve problems, but does not do it consistently.	Rarely uses an effective strategy to solve problems.
Mathematical Concepts	Explanation shows complete understanding of the mathematical concepts used to solve the problem(s).	Explanation shows substantial understanding of the mathematical concepts used to solve the problem(s).	Explanation shows some understanding of the mathematical concepts needed to solve the problem(s).	Explanation shows very limited understanding of the underlying concepts needed to solve the problem(s) OR is not written.
Mathematical Reasoning	Uses complex and refined mathematical reasoning.	Uses effective mathematical reasoning.	There is some evidence of mathematical reasoning.	There is little evidence of mathematical reasoning.
Neatness, Organization, Grammar and Spelling	The work is presented in a neat, clear, organized fashion that is easy to read.	The work is presented in a neat and organized fashion that is usually easy to read. Grammar and spelling are generally correct.	The work is presented in an organized fashion but may be hard to read at times. There are some grammar and spelling errors.	The work appears sloppy and unorganized. It is hard to know what information goes together. Grammar and spelling are poor.

Sun Pickles

Objectives

- Students will follow a recipe to make sun pickles.
- Students will measure ingredients carefully.
- Students will discover what is needed to make a pint of pickles.
- Students will discover what is needed to convert the recipe to make a quart of pickles and a gallon of pickles.

Overview of Lesson

Students learn how to make sun pickles and in the process, also learn units of measurement and measurement conversions.

Goal

Students will discover the process that occurs when ingredients, in conjunction with the sun, are combined to change cucumbers into pickles. Students will also discover standard cooking units of measurement and how to make conversions.

Ohio Academic Content Standards

Science

Scientific Inquiry (Grades 3-5)

Benchmark A:
Use appropriate instruments safely to observe, measure and collect data when conducting a scientific experiment.

Indicator:
1. Select and safely use the appropriate tools to collect data when conducting investigations and communicating findings to others (e.g., thermometers, timers, balances, spring scales, magnifiers, microscopes and other appropriate tools).

Science Standard

Physical Sciences

Benchmark A (Grade 4):
Compare the characteristics of simple physical and chemical changes.

Indicator:
2. Identify characteristics of a simple chemical change. When a new material is made by comgining two or more materials, it has chemical properties that are different from the original materials (e.g., burning paper, vinegar and baking soda).

Benchmark A (Grade 6):
Relate uses, properties and chemical processes to the behavior and/or arrangement of small particles that compose matter.

Indicators:
2. Describe that in a chemical change new substances are formed with different properties than the original substance (e.g., rusting, burning).

4. Describe that chemical and physical changes occur all around us (e.g., in the human body, cooking and industry).

Mathematics

Measurement (Grade 5)

Benchmark B:
Convert units of length, area, volume, mass and time within the same measurement system.

Benchmark E:
Use problem-solving techniques and technology as needed to solve problems involving length, weight, perimeter, area, volume, time and temperature.

Indicator:
5. Make conversions within the same measurement system while performing computations.

Materials

- Ingredients listed in recipe below
- Pint jars (Mason jars) with lids and rings
- Hot mitts for handling hot items
- A hotplate to boil water, or access to the school's kitchen

Procedure

Make sun pickles using the recipe below.

For each 500 ml (1 pint) jar:
Small cucumbers
Enough boiling water to cover the cucumbers
1 sprig of dill and a few dill seeds
2 tablespoons vinegar
1 tablespoon sugar
1 teaspoon salt

1. Wash the cucumbers. With a knife, make a lengthwise cut in them; pack them vertically into the jars in tight rows.
2. Add all the aromatic ingredients (dill, dill seeds, vinegar, sugar, salt); cover with boiling water (to ensure student safety, teacher should handle water and seal jars); mix well and close tightly.
3. Place the jars outdoors in full sunlight for 3 to 5 days, depending on the size of the cucumbers; taste to check progress.
4. Refrigerate afterward to stop the fermentation.
5. Have individual students fill in a chart (use included chart and make copies), showing conversion of ingredients needed to make a quart of pickles and a gallon of pickles.

Evaluation

Evaluate the students based on the completion of their charts. Give a percentage for the number of correct answers.

Sun Pickles Worksheet Conversion Chart

	1 pint	1 quart	1 gallon
Vinegar			
Sugar			
Salt			
Dill			

U.S. Measurement Equivalents

A few grains/pinch/dash, etc. (dry)	=	Less than 1/8 tsp
A dash (liquid)	=	A few drops
3 teaspoons	=	1 tablespoon
1/2 tablespoon	=	1-1/2 teaspoons
1 tablespoon	=	3 teaspoons
2 tablespoons	=	1 fluid ounce
4 tablespoons	=	1/4 cup
5-1/3 tablespoons	=	1/3 cup
8 tablespoons	=	1/2 cup
8 tablespoons	=	4 fluid ounces
10-2/3 tablespoons	=	2/3 cup
12 tablespoons	=	3/4 cup
16 tablespoons	=	1 cup
16 tablespoons	=	8 fluid ounces
1/8 cup	=	2 tablespoons
1/4 cup	=	4 tablespoons
1/4 cup	=	2 fluid ounces
1/3 cup	=	5 tablespoons plus 1 teaspoon
1/2 cup	=	8 tablespoons
1 cup	=	16 tablespoons
1 cup	=	8 fluid ounces
1 cup	=	1/2 pint
2 cups	=	1 pint
2 pints	=	1 quart
4 quarts (liquid)	=	1 gallon
8 quarts (dry)	=	1 peck
4 pecks (dry)	=	1 bushel
1 kilogram	=	approximately 2 pounds
1 liter	=	approximately 4 cups or 1 quart

Fruit Leathers

Objectives

- Students will measure fruit by weight.
- Students will dehydrate fruit and measure again, comparing weight with pre-dehydrated fruit.
- Students will discuss what physical change has taken place.

Overview of Lesson

Students make fruit leather snacks and learn about physical changes and measurements.

Goal

Students will learn about physical change, fractions, ratios, percents and weight.

Ohio Academic Content Standards

Science

Physical Science (Grade 6)

Benchmark A:
Relate uses, properties and chemical processes to the behavior and/or arrangement of the small particles that compose matter.

Indicator:
3. Describe that in a physical change (e.g., state, shape and size), the chemical properties of a substance remain unchanged.

Science

Physical Science (Grade 4)

Benchmark A:
Compare the characteristics of simple physical and chemical changes.

Indicator:
2. Identify characteristics of a simple physical change (e.g., heating or cooling can change water from one state to another and the change is reversible).

Mathematics

Number, Number Sense and Operations (Grades 5 & 6)

Benchmark D:
Use models and pictures to relate concepts of ratio, proportion and percent.

Indicators:
Grade 5
1. Use models of visual representations to develop the concept of part-to-part and part-to-whole, and the concept of percent as part-to-whole.

Grade 6
4. Describe what it means to find a specific percent of a number using real-life examples.

5. Use models and pictures to relate concepts of ratio, proportion and percent, including percents less than 1 and greater than 100.

9. Give examples of how ratios are used to represent comparison; e.g. part-to-part, part-to-whole, whole-to-part.

Mathematics

Measurement (Grades 5 – 6)

Benchmark A:
Select appropriate units to measure angles, circumference, surface, area, mass and volume, using: a) U.S. customary units; e.g., degrees, square feet, pounds and other units as appropriate; b) metric units; e.g., square meters, kilograms and other units as appropriate.

Benchmark B:
Convert units of length, area, volume, mass and time within the same measurement system.

Indicator:
Grade 5
5. Make conversions within the same measurement system while performing computations.

Materials

- Fruit of teacher's choice
- Food dehydrator, OR access to oven or warm place (like a car window)
- Accurate scale to weigh fruit
- Tool to slice fruit (either a knife or a food processing device)
- Cheesecloth to cover fruit (needed if dehydrating in the open air)
- Disposable plastic food gloves for sanitary purposes
- Plastic food wrap or wax paper

Procedure

1. Wash fruit.
2. Core (if needed).
3. Have the students weigh all fruit and record results (use plastic food wrap on scale and handle food while wearing plastic gloves).
4. Slice into very thin pieces.
5. Arrange in a single layer on trays.
6. Cover with cheesecloth. (Use this step *only* if dehydrating fruit in a warm place like on the dashboard of a car. *Do not* use cheesecloth in oven or dehydrator.)
7. Dehydrate until fruits are dry but pliable.
8. Have the students weigh results and compare to pre-dehydrating weights. (Use plastic food wrap on scale and handle food while wearing plastic gloves.) Use these numbers to develop ratios, fractions and percents.
9. Once the fruit is ready, let the students eat it!
10. Have students write out the process they used, and what they discovered.

Evaluation

Use Fruit Leathers rubric to determine students' performance.

Rubric: Fruit Leathers

CATEGORY	4	3	2	1
Strategy/ Procedures	Typically uses an efficient and effective strategy to solve the problem(s).	Typically uses an effective strategy to solve the problem(s).	Sometimes uses an effective strategy to solve problems, but does not do it consistently.	Rarely uses an effective strategy to solve problems.
Scientific Concepts	Explanation shows complete understanding of the scientific concepts used to solve the problem(s).	Explanation shows substantial understanding of the scientific concepts used to solve the problem(s).	Explanation shows some understanding of the scientific concepts needed to solve the problem(s).	Explanation shows very limited understanding of the underlying concepts needed to solve the problem(s) OR is not written.
Scientific Reasoning	Uses complex and refined scientific reasoning.	Uses effective scientific reasoning.	Shows some evidence of scientific reasoning.	Shows little evidence of scientific reasoning.
Neatness, Organization, Grammar and Spelling	The work is presented in a neat, clear, organized fashion that is easy to read.	The work is presented in a neat and organized fashion that is usually easy to read. Grammar and spelling are generally correct.	The work is presented in an organized fashion but may be hard to read at times. There are some grammar and spelling errors.	The work appears sloppy and unorganized. It is hard to know what information goes together. Grammar and spelling are poor.

Food Preservation

Food preservation is the "process of treating and handling food in such a way as to stop or greatly slow down spoilage to prevent food-borne illness while maintaining nutritional value, texture and flavor." (**Source: en.wikipedia.org/wiki/Food_preservation**)
Because food is so important to survival, food preservation is one of the oldest technologies used by human being.

What does food preservation do?

Basically food preservation involves slowing down or preventing the growth of bacteria, fungi and other microorganisms, as well as slowing the oxidation of fat or rancidity. Also included is the process of slowing the aging and discoloration that occurs.

What are the types of preservation?

The preservation processes include:

- **Heating** (boiling to kill microorganisms) – Heat inactivates microorganisms.
- **Smoking** (or using carbon dioxide, vinegar or alcohol) – Carbon dioxide slows the growth of some microorganisms.
- **Dehydration** (drying) – Drying reduces water activity and delays or prevents growth of microorganisms.
- **Low temperatures** (freezing) – Low temperatures retard growth and reduce water activity.
- **Vacuum sealing** – Low oxygen inhibits the growth of microorganisms.
- **Food Irradiation** – Food products are exposed to a controlled amount of radiant energy. Not common in the United States.
- **Combinations** of all listed above.

Definitions

Bacteria

Bacteria are among the earliest forms of life that appeared on Earth billions of years ago. There are thousands of species of bacteria, but all of them are basically one of three different shapes:

- Bacilli (pronounced buh-sill'-eye), which are shaped like rods or sticks.
- Cocci (pronounced cox'-eye), which are shaped like little balls.
- Helical - or spiral-shaped.

Bacteria are the most abundant of all organisms. They exist in soil and water, and as symbionts (two unlike organisms that live together for their mutual benefit) of other organisms. Many pathogens are bacteria. Most are minute, usually only 0.5-5.0 μm in size, though one type may reach 0.3 mm in diameter. Many move around using flagella, a whip-like organelle (one of several structures with specialized functions) that many unicellular organisms, and some multicellular ones, use to move about.

Fungi

Fungi have similar characteristics to plants and are sometimes mistakenly put in the plant kingdom, but plants have chlorophyll that helps them make their own food and makes them green. Fungi have no chlorophyll. Fungi decay dead organic matter or grow on other organisms to get food for growth. Molds, rusts, mildews, smits, mushrooms and yeasts are all fungi.

Microorganism

A microorganism, or microbe, is an organism that is so small that it is microscopic (invisible to the naked eye). The study of microorganisms is called microbiology.

Microorganisms are found everywhere in nature. Even in hostile environments, like the poles, deserts, geysers, rocks and the deep sea, some types of microorganisms have adapted to the extreme conditions and maintained colonies; these organisms are known as extremophiles.

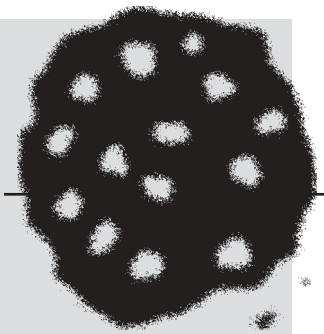
Microorganisms are used in baking, biotechnology, recycling of other organisms' remains and waste products and many other processes. They can also be harmful as pathogens (causative agents of disease) when, as parasites, they cause infections.

Math and Science

Gumbo

Bake Shop

www.pbs4549.org/gumbo



Doubling and Tripling Recipes

NOTE: This lesson uses peanut butter. If any students in the class have nut allergies, then do not use this lesson.

Objectives

- Students will make no-bake cookies.
- Students will carefully measure each ingredient.
- Students will double the recipe (and triple, if so desired).
- Students will create a chart showing the results of doubling (and/or tripling) the recipe.

Ohio Academic Content Standards

Mathematics (Grades 3-4)

Patterns, Functions and Algebra

Benchmark A:
Analyze and extend patterns, and describe the rule in words.

Benchmark B:
Use patterns to make predictions, identify relationships and solve problems.

Benchmark G:
Describe how a change in one variable affects the value of a related variable.

Indicators:

3. Use patterns to make predictions, identify relationships and solve problems.

7. Create tables to record, organize and analyze data to discover patterns and rules.

Overview of Lesson

Students learn how to double and triple the supplied recipe for no-bake cookies.

Goal

Students will learn what happens when a recipe is doubled (and/or tripled).

Materials

- Cookie sheets
- Mixing bowls
- Spatulas
- Measuring spoons
- Measuring cups
- Wax paper
- Ingredients specified in recipe

Procedure

1. Divide the students into groups of three or four.
2. Give each group the recipe on the following page.
3. Give each group a cookie sheet, mixing bowl, spatula, spoon and wax paper.

Extension

Tell students that they are going to plan a party for the class next door and are going to bake cookies. Using the supplied chart in the appendix, have the students write in the amount of ingredients needed if they multiply the recipe by two, three and four.

Evaluation

Use students' achievement on the completion of the chart to evaluate their performance.

Recipe

Easy 5-in-1 No-Bake Cookies

by Rachel Keller
Courtesy of AllHomemadeCookies.com

These no-bake cookies are tasty and nutritious. The basic recipe makes several different cookies. Add your favorite ingredients to make your own unique cookie. The orange juice concentrate gives the cookies an orange flavor.

Begin with the following ingredients:

½ cup peanut butter

½ cup honey or corn syrup

¼ cup orange juice concentrate

1 ½ cups nonfat dry milk solids

Mix thoroughly.

Now choose one of the following five steps:

1. O-Rs

2 cups rolled oats

1-½ cups raisins

Mix. Shape into balls and then flatten. Makes 3 dozen medium cookies.

2. Crispy Balls

4 cups crispy cereal

Mix. Shape into small balls. Makes 4 dozen small balls.

3. Raisin Clusters

¼ cup cocoa

4 cups raisins

Mix. Cluster into small balls. Makes about 4 dozen small clusters.

4. Co-co Balls

¼ cup cocoa

2 cups rolled oats

¼ cup chopped peanuts

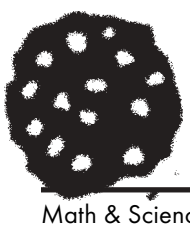
1 tsp. vanilla

Mix. Shape into balls. Makes 2 ½ dozen cookie balls.

5. Grahamys

¼ cup raisins

Spread between graham crackers. Makes about 3 dozen.



Doubling and Tripling Recipe Chart

Single recipe	2x	3x	4x
1/2 cup peanut butter			
1/4 cup orange juice concentrate			
4 cups miniature marshmallows			
1-1/2 cups nonfat dry milk solids			

Single recipe Insert ingredients from one of the five steps above in the spaces below.	2x	3x	4x

Pumpkin Problem

Objective

Students will use the information provided in the story to solve problems.

Overview of Lesson

Students use their reading and investigative skills to solve problems.

Goal

Students will read a problem using analytical skills and look for clues to solving problems.

Ohio Academic Content Standards

Mathematics

Number, Number Sense and Operations

Benchmark E:
Use order of operations, including use of parentheses and exponents to solve multi-step problems, and verify and interpret results.

Benchmark I:
Use a variety of strategies, including proportional reasoning, to estimate, compute, solve and explain solutions to problems involving integers, fractions, decimals and percents.

Indicators:
Grade 5
3. Identify and generate equivalent forms of fractions, decimals and percents.

8. Identify and use relationships between operations to solve problems.

9. Use order of operations including use of parentheses to simplify numerical expressions.

Grade 6
7. Use simple expressions involving integers to represent and solve problems, e.g., if a running back loses 15 yards on the first carry but gains 8 yards on the second carry, what is the net gain/loss?

Mathematics

Measurement

Benchmark B:
Convert units of length, area, volume, mass and time within the same measurement system.

Benchmark E:
Use problem-solving techniques and technology as needed to solve problems involving length, weight, perimeter, area, volume, time and temperature.

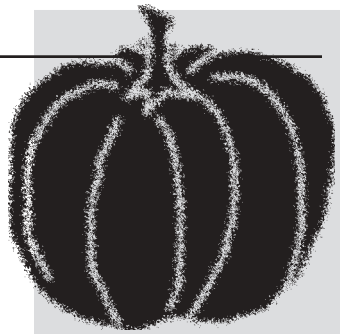
Indicator:
Grade 5
5. Make conversions within the same measurement system while performing computations.

Science

Physical Sciences

Benchmark A:
Compare the characteristics of simple physical and chemical changes.

Indicator:
1. Identify characteristics of a simple physical change (e.g., heating or cooling can change water from one state to another and the change is reversible).



Science
Scientific Inquiry

Benchmark B:
Organize and evaluate observations, measurements and other data to formulate inferences and conclusions.

Indicators:
Grade 3
5. Record and organize observations (e.g., journals, charts and tables).

Grade 5
2. Evaluate observations and measurements made by other people and identify reasons for any discrepancies.

Science
Scientific Ways of Knowing

Benchmark A:
Distinguish between fact and opinion and explain how ideas and conclusions change as new knowledge is gained.

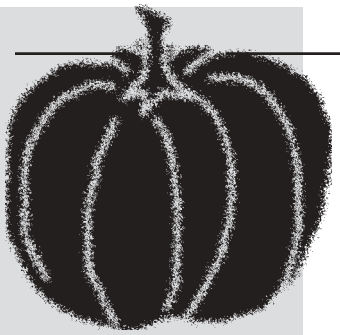
Indicator:
Grade 5
1. Summarize how conclusions and ideas change as new knowledge is gained.

Materials

- A copy of the story and questions for each partnership or group
- Calculators
- Paper
- Pencils
- A table of appropriate units for conversion

Procedure

1. Ask students to share what they know about pumpkins. To motivate students, sharing some of the record weights and/or the history of pumpkins in this country would set the tone for the activity.
2. Students work in small groups, following along as the teacher reads the pumpkin story included in this lesson.
3. Once the story has been read, distribute the question sheet. Allow students time to answer several questions. Since it will take time to answer several of the questions, decide which questions all students should solve and/or select three or four questions to give to only two or three groups.
4. Share answers and discuss processes for finding solutions.

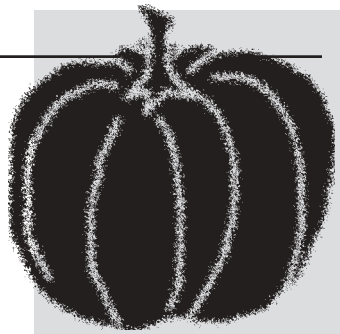


Questions

1. How many ounces are there in 166 pounds?
   Answer: 166 x 16 = 2656
2. About how many chunks of the same size of the original piece could be cut from this pumpkin? Is there a way to find the answer to this question with the information that is presented?
   Answer: 166 / 20 = 8.3
3. How many dozen seeds were inside this pumpkin?
   Answer: 523 / 12 = 43.583
4. If each seed was the size of a quarter, how many school desks could be covered with the seeds?
   Answer: This depends upon the size of the desk. Measure the desk, measure a quarter then divide the desk size by the quarter size for length and width.
5. If nine bags are used to hold the pumpkin shells, how many gallons of shells are there?
   Answer: 9 x 13 = 117
6. How many gallons of filling had been used before the donation to the senior center?
   Answer: 24 – 21 = 3 quarts (or __ gal.). 21 quarts used.
7. How many pies could be made from total amount of filling?
   Answer: 4 cup (1 quart) x 21 quarts = 84 cups
   84 cups / 2 cups (2 cups needed for each pie) = 42 pies
8. If four pies could be baked at one time and it takes 45 minutes to bake each batch of pies, how long would it take to bake 16 pies? How long would it take to bake all the pies that could be made from this much filling?
   Answer: For 16 pies
   16 / 4 = 4 pies x 45 mins = 180 mins / 60 mins = 3 hours
   For all the pies (48)
   48 pies / 4 = 12 x 45 = 540 mins / 60 mins = 9 hours

Evaluation

Use a percentage of the number of correct answers.



Extensions

1. Students get real pumpkins from a farm or the store – enough for four to six small groups. They measure and weigh them, then scoop out the insides and count the seeds.
2. The students create line plots and data analysis terms to consider the findings of the classroom sample.
3. Have the students discuss what else they would like to know about pumpkins. They can go to the Internet and gather additional data.
4. Students can create a newsletter with articles such as "Strange and Bizarre Facts," "Record-making Pumpkins," and "Pumpkin Colors." Share copies with the school.
5. Students can use the story of Cinderella to do an inquiry. Based upon the typical size of a carriage at the time of the story, what size of a pumpkin would be needed to match the size of the carriage?
6. Using the data from the pumpkin story, have the students figure out how many seeds would be inside and how many pies could be made. Or have students obtain information about prize-winning pumpkins. They can then answer the above questions using the new information. This time, students predict the number of seeds that would be inside the giant pumpkins. They make a table to hold the information and draw conclusions based upon their experiences.

Useful Web site

www.vrg.org/recipes/vjpumpkin.htm. This is a resource page for vegetarian cooking. It has some useful information about using pumpkin in recipes other than those to make pie.

Questions

1. How many ounces is 166 pounds?
   Answer:

2. About how many chunks the same size of the original piece could be cut from this pumpkin? Is there a way to find the answer to this question with the information that is presented?
   Answer:

3. How many dozen seeds were inside this pumpkin?
   Answer:

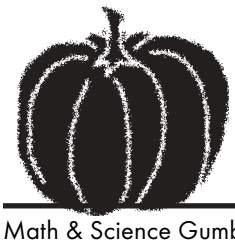
4. If each seed was the size of a quarter, how many school desks could be covered with the seeds?
   Answer:

5. If 9 bags were used to hold the pumpkin shells, how many gallons of shells were there?
   Answer:

6. How many gallons of filling had been used before the donation to the senior center?
   Answer:

7. How many pies could be made from total amount of filling?
   Answer:

8. If four pies could be baked at one time and it takes 45 minutes to bake each batch of pies. How long would it take to bake the 16 pies? How long would it take to bake all the pies that could be made from this much filling?
   Answer:



A Pumpkin Story

A woman won a contest for guessing the weight of a giant pumpkin, which weighed 166 pounds. She invited a pumpkin fancier to provide suggestions for using the pumpkin because she had no idea what to do with it.

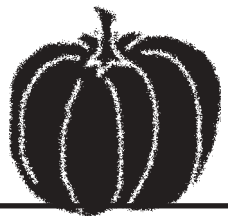
The pumpkin fancier attempted to cut into the pumpkin, but it was tough going. The chunk he was able to cut from the top weighed 20 pounds. It was the size of a hubcap and the skin, believe it or not, was 5 inches thick.

Inside the pumpkin was a stringy, gooey mess that included many seeds. Altogether there were 523 seeds, and each seed was the size of a quarter. Once the insides were taken out, the pair made a giant jack-o-lantern – for photographic purposes only.

After "Jack" smiled for the camera, he was cut to bits. The skin with the attached flesh is what's used to make pie filling. It took nine 13-gallon bags to hold it all. The bags were transported to the pumpkin man's house in his hatchback. The entire area was needed to transport the bags of pumpkin.

To prepare for pie, pieces of pumpkin were placed on cookie sheets and baked for 45 minutes at 350 degrees F. Four filled cookie sheets were cooked at a time. Each batch was cooled, then the flesh was scraped from the peel into a bowl. This was then sieved to make the pie filling smooth. Once the skin, seeds and water were removed, 25 quarts of pumpkin was obtained.

A standard pumpkin pie recipe calls for 2 cups of pumpkin per pie. Each batch of filling made two pies. This baker made 16 pies before getting tired. After the pies were given away to friends and acquaintances, he still had 21 quarts of pumpkin left. The remaining 21 quarts of pumpkin were donated to a senior center. It is thought that the residents at the center used the pumpkin for even more pies, but who knows. Hopefully this story ends happily and something yummy was made.



Chemical and Physical Changes

Objectives

- Students will follow directions on the worksheets.
- Students will discover what physical and chemical changes occur to the balloons and the pretzels.
- Students will write their reflections to the questions concerning physical and chemical changes.

Ohio Academic Content Standards

Physical Sciences

Benchmark A:
Compare the characteristics of simple physical and chemical change.

Indicators:
Nature of Science: Grade 4
1. Identify characteristics of simply physical change.

2. Identify characteristics of simple chemical change.

Scientific Inquiry

Benchmark C:
Use appropriate instruments safely to observe measure and collect data when conducting a scientific investigation.

Benchmark C:
Develop, design and safely conduct scientific investigations and communicate the results.

Indicators:
Doing Scientific Inquiry: Grade 3
1. Select the appropriate tools and use relevant safety procedures to measure and record length and weight in metric and English units.

2. Discuss observations and measurements made by other people.

3. Read and interpret simple tables and graphs produced by self/others.

5. Record and organize observations (e.g., journals, charts and tables).

6. Communicate scientific findings to others through a variety of methods (e.g., pictures, written, oral and recorded observations).

Doing Scientific Inquiry: Grade 4
1. Select the appropriate tools and use relevant safety procedures to measure and record length, weight, volume, temperature and area in metric and English units.

3. Develop, design and conduct safe, simple investigations or experiments to answer questions.

4. Explain the importance of keeping conditions the same in an experiment.

5. Describe how comparisons may not be fair when some conditions are not kept the same between experiments.

6. Formulate instructions and communicate data in a manner that allows others to understand and repeat an investigation or experiment.

Overview of Lesson

Through simple lessons involving a balloon and a pretzel, students learn about simple chemical and physical changes, and the difference between the two.

Goal

Students will understand the characteristics of simple chemical and physical changes in foods.

Materials

- Balloons
- Stick pretzels
- Napkins
- Magnifying glass
- Scale
- Linear measuring tool

Optional Items for Extension

- Gum
- Water
- Vinegar
- Baking soda

Procedure

Lesson 1

1. Distribute Physical Changes worksheet and discuss vocabulary and background information.
2. Follow the direction on the worksheet together. Be sure to stop and discuss student answers about the changes in the balloon.

Lesson 2

1. Distribute Chemical and Physical Changes worksheet and pretzels.
2. After students have drawn their pictures of a pretzel, discuss the term "quantitative observations" (how big, small, heavy, long, etc.). As students measure their pretzels in Part 1, determine as a class which way to hold the pretzel to measure its length, width and height.
3. Discuss the term "qualitative observations" (using your senses). As students describe the properties of their pretzels, record this information on the board. NOTE: Do not let students taste their pretzels at this point. They will do this during Step 4.
4. Work through Step 4 together. Some students may be reluctant to take the chewed pretzel out of their mouths to look at it on a napkin. If so, have them mash a pretzel into small pieces and mix it with a small amount of water.
5. On their own, have students complete the reflection section. Share these answers at a later time.

Evaluation

Students will be evaluated on the individual work during these two experiments and how well they performed on the reflection. Use the included rubric for evaluation.

Background Information

Physical Changes

When you jump into a swimming pool, your swimsuit gets wet but it's still a swimsuit. If you break a glass, you change its shape but the pieces are still glass. If you freeze water into ice cubes, you change its state of matter but it is still just water. When you change an object's state of matter, the change can be reversed. For example, water (liquid) that changes to ice (solid) can be changed back into water. It can also be changed to steam (gas) and back into water again.

Chemical Changes

When two or more materials combine to make a new material, the new material has chemical properties that are different from the original materials. When you burn a piece of paper, you've added fire to the original material, which changes the paper into ashes. This procedure cannot be reversed in order to change the ashes back into paper. When you mix vinegar and baking soda you get a chemical reaction. The two materials combine together to make a new substance that cannot be separated to form its original parts. When you take a bite of a pretzel, saliva from your mouth begins mixing with the pretzel in order to "break down" the pretzel for your body to digest. This process cannot be reversed in order to return the pretzel back to its original form.

Answers for Extension Questions

Question 1.

B. The smell and color change of the rotting potato

Question 2. Which of the following actions causes only a physical change and not a chemical change?

A. Tearing a tissue paper

Rubric: Chemical and Physical Changes

CATEGORY	4	3	2	1
Strategy/ Procedures	Typically uses an efficient and effective strategy to solve the problem(s).	Typically uses an effective strategy to solve the problem(s).	Sometimes uses an effective strategy to solve problems, but does not do it consistently.	Rarely uses an effective strategy to solve problems.
Mathematical and Scientific Concepts	Explanation shows complete understanding of the mathematical and scientific concepts used to solve the problem(s).	Explanation shows substantial understanding of the mathematical and scientific concepts used to solve the problem(s).	Explanation shows some understanding of the mathematical and scientific concepts needed to solve the problem(s).	Explanation shows very limited understanding of the underlying concepts needed to solve the problem(s) OR is not written.
Mathematical and Scientific Reasoning	Uses complex and refined mathematical and scientific reasoning.	Uses effective mathematical and scientific reasoning.	Shows some evidence of mathematical and scientific reasoning.	Shows little evidence of mathematical and scientific reasoning.
Neatness, Organization, Grammar and Spelling	The work is presented in a neat, clear, organized fashion that is easy to read.	The work is presented in a neat and organized fashion that is usually easy to read. Grammar and spelling are generally correct.	The work is presented in an organized fashion but may be hard to read at times. There are some grammar and spelling errors.	The work appears sloppy and unorganized. It is hard to know what information goes together. Grammar and spelling are poor.

Student Worksheet

Part 1: Physical Changes

Name _____ Date _____

Definitions

Physical change: A change in the appearance, size, shape or state of matter.

Matter: The substance of which an item is composed.

Chemical change: A complete change in matter that results in a new substance that behaves in different ways than the original substance.

Step 1: Place a balloon on your desk. Do not blow it up. On the back of this worksheet, draw a picture of your balloon. Be sure to color it.

Step 2: Blow up the balloon and pinch the opening shut. Be sure to hold the balloon tightly in front of you. Now draw a picture of your blown-up balloon on the back of this worksheet.

Question: What changed about the balloon?

Question: Is this a physical or chemical change? How do you know?

Step 3: Keep holding onto the balloon as you slowly let the air out. Draw a picture of the deflated balloon.

Question: How does the shape of the balloon in Step 3 compare to the way it looked in Step 1 and 2?

Part 2: Chemical And Physical Changes

Name _____ Date _____

Step 1: On the back of this worksheet, draw a picture of the pretzel.

Step 2: Conduct these quantitative observations:

Length: ____cm, or ____in Width: ____ cm, or ____in

Height: ____cm, or ____in Weight: _____ g.

Step 3: Use the following qualitative observations (your senses) to describe the pretzel:

Feel _____

Smell _____

Hear _____

See _____

Step 4: Complete the following questions for discussion:

What can you do to physically change the pretzel but still tell that it is a pretzel? _____

_____

_____

Take a small bite of your pretzel. What mixes with your pretzel while you are chewing?

_____

_____

Place a small piece of the chewed pretzel on a tissue (or mash a pretzel into small pieces and add a small amount of water). How has the pretzel changed from its original form? _____

_____

_____

Reflection (in science journals)

Extension

l. Pretend that you have two potatoes. One potato is rotting. You are mashing the other potato. You want to find out which potato is going through a chemical change. What information will help you decide?

A. The change in shape of the mashed potato

B. The smell and color change of the rotting potato

C. The mashed potato becoming softer than it was

Why?

2. Which of the following actions causes only a physical change and not a chemical change? Why?

A. Tearing a tissue paper

B. Burning a match

C. Baking a cake

3. What could you do to show that water changing to ice is a physical change?

Make It Hot! Hot! Hot! (Temperature Conversion)

Objective

Students will use sample problems to learn how to convert between Fahrenheit and Celsius temperature scales.

Ohio Academic Content Standards

Mathematics

Measurement (Grade 5)

Benchmark B:
Convert units of length, area, volume, mass and time within the same measurement system.

Benchmark E:
Use problem-solving techniques and technology as needed to solve problems involving length, weight, perimeter, area, volume, time and temperature.

Indicator:
5. Make conversions within the same measurement system while performing computations.

Overview of Lesson

Working together, students learn about the conversion process from Fahrenheit to Celsius, and vice versa.

Goal

Students will understand the Fahrenheit and Celsius temperature scales.

Materials

- Calculator
- Pencil
- Paper

Procedure

The conversion process from Fahrenheit to Celsius can be very simple for younger students to learn if the procedures are presented as a multiple-step problem. During this lesson, students will discover that baking requires a much higher temperature than boiling water (cookies usually bake between 350 F to 375 F; pie crusts bake at 400 F). Eventually, students will be asked to develop some rules for determining whether or not a temperature is Fahrenheit or Celsius.

1. Ask students about the boiling and freezing temperatures of water. Continue with a discussion about a very warm or very cool day. Ask what the temperature might be on a cool day and a warm day.
2. Show students the example of converting 50 F to 10 C, and vice versa.

Example:

Fahrenheit to Celsius
1. 50 F – 32 = 18
2. 18 F x 5 = 90
3. 90 / 9 = 10 C

Celsius to Fahrenheit
1. 10 C x 9 = 90
2. 90 / 5 = 18 F
3. 18 F + 32 = 50 F

3. Working in pairs, ask the students to convert the temperature of boiling water from Fahrenheit to Celsius. Discuss the results. Next have the students convert the freezing temperature of water from Celsius to Fahrenheit.

4. Help students make a class table so students can see the comparison between the boiling point of Fahrenheit and Celsius temperatures.
5. Ask students whether or not 212 F would be warm enough to bake bread or cook a roast. See if any students are aware of the temperature range on a standard oven. Let students know about the typical temperatures for baking cookies (350 – 375 F) and pie crusts (400 F), and for broiling a steak (425 F). Do not indicate which system these numbers represent.
6. Divide the students into small groups. Each group is responsible for making a conversion.

Group A, 350 C to F	Group D, 425 F to C
Group B, 350 F to C	Group E, 550 C to F
Group C, 425 C to F	Group F, 550 F to C

7. Now share the following information:
   A red clay planter bakes (fires) at 1200 F, which is 648.8 C. Ask the students if they think food would cook at the same temperatures that are used to make plates and planters. Celsius temperature equivalents are lower than Fahrenheit temperatures because the range is from 0 degrees to 100 degrees. For water freezing and boiling, refer back to Step 3.
8. Review the numbers that the students have converted in Step 6. Ask the group if the temperatures are Fahrenheit or Celsius. Volunteers should support their answers based upon observations made during this lesson.

Answers to Step 6

Group A, 350 C = 662 F	Group D, 425 F = 218.3 C
Group B, 350 F = 176.7 C	Group E, 550 C = 1022 F
Group C, 425 C = 797 F	Group F, 550 F = 287.8 C

Conclusion: Have the students brainstorm about ways to determine to which system a temperature might belong. For example, people could not walk around in temperatures that are higher than the temperature of boiling water. A temperature for the day that is 100 degrees can't be in Celsius, because no one could live at that temperature. Water would not freeze at 32 C, but that temperature does describe a warm day.

More advanced students could use the following formulas:

To convert from F (Fahrenheit) to C (Celsius): $C = 5/9 \times (F - 32)$

To convert C (Celsius) from to F (Fahrenheit): $F = (1.8 \times C) + 32$

Evaluation

Students can make a journal entry response to this question. Which temperature is better for foods in the freezer: 0 C or 0 F? Is it recommended that freezers be at -40 degrees F? Will the food be safe at 0 degrees on either system?

Use the included rubric for evaluation.

Rubric: Temperature Conversion

CATEGORY	4	3	2	1
Strategy/ Procedures	Typically uses an efficient and effective strategy to solve the problem(s).	Typically uses an effective strategy to solve the problem(s).	Sometimes uses an effective strategy to solve problems, but does not do it consistently.	Rarely uses an effective strategy to solve problems.
Scientific Concepts	Explanation shows complete understanding of the scientific concepts used to solve the problem(s).	Explanation shows substantial understanding of the scientific concepts used to solve the problem(s).	Explanation shows some understanding of the scientific concepts needed to solve the problem(s).	Explanation shows very limited understanding of the underlying concepts needed to solve the problem(s) OR is not written.
Scientific Reasoning	Uses complex and refined scientific reasoning.	Uses effective scientific reasoning.	Shows some evidence of scientific reasoning.	Shows little evidence of scientific reasoning.
Neatness, Organization, Grammar and Spelling	The work is presented in a neat, clear, organized fashion that is easy to read.	The work is presented in a neat and organized fashion that is usually easy to read. Grammar and spelling are generally correct.	The work is presented in an organized fashion but may be hard to read at times. There are some grammar and spelling errors.	The work appears sloppy and unorganized. It is hard to know what information goes together. Grammar and spelling are poor.

Chemical and Physical Change

Matter is something that occupies space (volume) and has weight (mass). There are three states of matter: **solid, liquid and gas**. A solid has a certain size and shape. A liquid has a size or volume. That means it takes up space, but it conforms to the container so it has no definite shape. Gases have no size or shape of their own.

Matter can be classified as a **mixture** or a **pure substance.** A mixture has two or more kinds of particles and may, therefore, have different properties in different samples. A pure substance has the same properties in any sample you choose.

Physical change is a change in matter where no new substance is produced. **Chemical change** is a change in matter that produces a new substance. Some clues that a chemical change has taken place include a change in the smell or the color of the matter. Sometimes a gas is formed. Chemical changes cannot be reversed without extraordinary means – if at all.

Example:

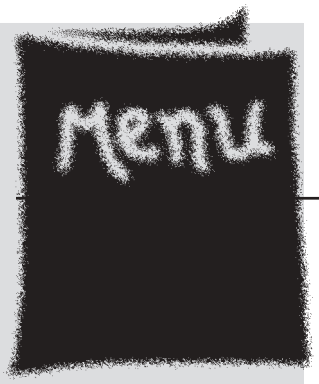
- Water can change from ice (solid) to water (liquid) to steam (gas). This is a physical change because it can be reversed.
- Take that same water. Mix it with ingredients and bake a cake. This is a chemical change because it would take extraordinary means to separate the ingredients into the form they held before the cake was baked.

Math and Science

Gumbo

Restaurant

www.pbs4549.org/gumbo



Overhead and Profit

Objectives

- Students will utilize a formula to calculate the overhead and profit of a restaurant.
- Students will compare and contrast the difference in cost of items in a similar type of restaurant.
- Students will compare the costs of eating at different restaurants.

Overview of Lesson

Students gain an understanding of the costs involved in running a restaurant.

Goal

Students will calculate the overhead and profit of a restaurant.

Ohio Academic Content Standards

Mathematics

Number, Number Sense and Operations
(Grades 3-4)

Benchmark A:
Use place value structure of the base-ten number system to read, write, represent and compare whole numbers and decimals.

Benchmark J:
Estimate the results of whole number computations using a variety of strategies, and judge the reasonableness.

Benchmark K:
Analyze and solve multi-step problems involving addition, subtraction, multiplication and division of whole numbers.

Indicators:
Grade Three
Computation and Estimation
12. Add and subtract whole numbers with and without regrouping.

Grade Four
Meaning of Operations
7. Recognize that division may be used to solve different types of problem situations and interpret the meaning of remainders; e.g., situations involving measurement, money.

Computation and Estimation
12. Analyze and solve multi-step problems involving addition, subtraction, multiplication and division using an organized approach, and verify and interpret results with respect to the original problem.

13. Use a variety of methods and appropriate tools for computing with whole numbers; e.g., mental math, paper, pencil and calculator.

14. Demonstrate fluency in adding and subtracting whole numbers and in multiplying and dividing whole numbers by one- and two-digit numbers and multiples of 10.

Mathematics

Number, Number Sense and Operations
(Grade 6)

Benchmark F:
Apply number system properties when performing computations.

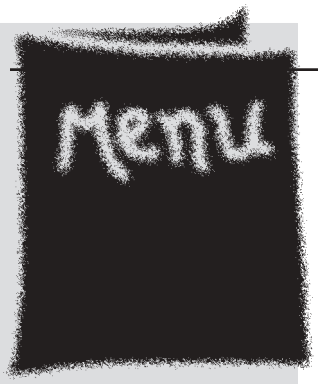
Benchmark G:
Apply and explain the use of prime factorizations, common factors and common multiples in problem situations.

Benchmark I:
Use a variety of strategies, including proportional reasoning, to estimate, compute, solve and explain solutions to problems involving integers, fractions, decimals and percents.

Indicators:
Grade Six
Number and Number Systems
3. Explain why a number is referred to as being rational, and recognize that the expression $\frac{a}{b}$ can mean a parts of size $\frac{1}{b}$ each, a divided by b, or the ratio of a to b.

4. Describe what it means to find a specific percent of a number, using real-life examples.

Computation and Estimation
14. Use proportional reasoning, ratios and percents to represent problem situations and determine the reasonableness of solutions.

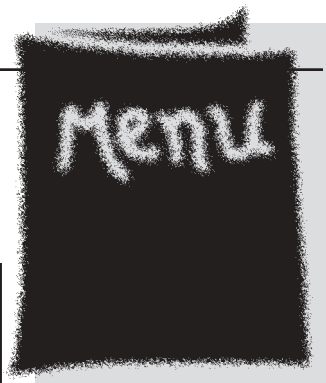


Materials

- Online menus or any other menus from a local restaurant

Procedure

1. Have students choose a menu from which they would like to work. Students (or teachers) can find menus online by searching for online menus, or they may use a carryout menu from a local restaurant. Go to **www.pbs4549.org/gumbo** for online menus.
2. Explain to students how a restaurant determines the cost of a meal. For example: If a restaurant pays $2 to provide a dinner to a customer, the customer usually pays three times that amount, or $6, for the meal. The extra $4 pays for the overhead (rent, utilities, salaries, etc.) and for the profit (money that goes to the owner). Most restaurants use the following formula: The cost of the meal multiplied by 2 ($2 • 2 = $4) equals the cost of the meal and the overhead. The cost of the meal multiplied by 3 ($2 • 3 = $6) equals the cost of the meal, the overhead and the profit.
3. Have students compare the cost of similar meals (i.e. hamburger, french fries, salad and a drink) at three different restaurants (you may use the included student handout). Go to **www.pbs4549.org/gumbo** for online menus.
4. Have the students take the price of the meal from the three restaurants (remember, this is the actual price paid by the customer) and determine the cost, overhead and profit for each restaurant.
5. Challenge: Older students can find the percentage of money saved by comparing the costs of similar meals. Have the students write their results at the bottom of the handout.



Evaluation

Rubric: Overhead and Profit

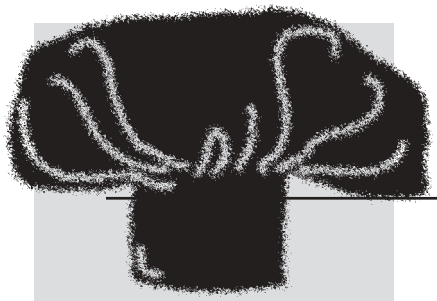
CATEGORY	4	3	2	1
Strategy/ Procedures	Typically uses an efficient and effective strategy to solve the problem(s).	Typically uses an effective strategy to solve the problem(s).	Sometimes uses an effective strategy to solve problems, but does not do it consistently.	Rarely uses an effective strategy to solve problems.
Mathematical Concepts	Explanation shows complete understanding of the mathematical concepts used to solve the problem(s).	Explanation shows substantial understanding of the mathematical concepts used to solve the problem(s).	Explanation shows some understanding of the mathematical concepts needed to solve the problem(s).	Explanation shows very limited understanding of the underlying concepts needed to solve the problem(s) OR is not written.
Mathematical Reasoning	Uses complex and refined mathematical reasoning.	Uses effective mathematical reasoning.	Shows some evidence of mathematical reasoning.	Shows little evidence of mathematical reasoning.
Neatness, Organization, Grammar and Spelling	The work is presented in a neat, clear, organized fashion that is easy to read.	The work is presented in a neat and organized fashion that is usually easy to read. Grammar and spelling are generally correct.	The work is presented in an organized fashion but may be hard to read at times. There are some grammar and spelling errors.	The work appears sloppy and unorganized. It is hard to know what information goes together. Grammar and spelling are poor.

Actual Cost of Food

Restaurant Name:	Restaurant Name:	Restaurant Name:
Hamburger:	Hamburger:	Hamburger:
French Fries:	French Fries:	French Fries:
Salad:	Salad:	Salad:
Drink:	Drink:	Drink:
Cost of Meal:	Cost of Meal:	Cost of Meal:
Amount of Overhead:	Amount of Overhead:	Amount of Overhead:
Amount of Profit:	Amount of Profit:	Amount of Profit:

Actual Cost of Food

Restaurant Name:	Restaurant Name:	Restaurant Name:
Hamburger:	Hamburger:	Hamburger:
French Fries:	French Fries:	French Fries:
Salad:	Salad:	Salad:
Drink:	Drink:	Drink:
Cost of Meal:	Cost of Meal:	Cost of Meal:
Amount of Overhead:	Amount of Overhead:	Amount of Overhead:
Amount of Profit:	Amount of Profit:	Amount of Profit:



The Cost of Running a Restaurant

Objectives

- Students will calculate the fixed costs of operating Cyd's Corner Café.
- Students will determine how many meals must be sold in order for a restaurant to either break even or make a profit.

Overview of Lesson

This lesson looks at the costs of running a restaurant, Cyd's Corner Café, and what the restaurant owner must sell to stay in business.

Goal

Students will gain an understanding of the costs involved in running a restaurant.

Ohio Academic Content Standards

Mathematics

Number, Number Sense and Operations
(Grades 3-4)

Benchmark A:
Use place value structure of the base-ten number system to read, write, represent and compare whole numbers and decimals.

Benchmark I:
Demonstrate fluency in multiplication facts with factors through 10 and corresponding divisions.

Benchmark K:
Analyze and solve multi-step problems involving addition, subtraction, multiplications and division of whole numbers.

Benchmark L:
Use a variety of methods and appropriate tools (mental math, paper and pencil, calculators) for computing with whole numbers.

Indicators:
Grade 3
Meaning of Operations
10. Explain and use relationships between operations, such as: a) relate additions and subtraction as inverse operations; b) relate multiplication and division as inverse operations; c) relate addition to multiplication (repeated addition); d) relate subtraction to division (repeated subtraction).

Computation and Estimation
12. Add and subtract whole numbers with and without regrouping.

14. Multiply and divide 2- and 3-digit numbers by a single-digit number, without remainders for division.

Grade 4
Computation and Estimation
12. Analyze and solve multi-step problems involving addition, subtraction, multiplication and division using an organized approach, and verify and interpret results with respect to the original problem.

14. Demonstrate fluency in adding and subtracting whole numbers and in multiplying and dividing whole numbers by 1- and 2-digit numbers and multiples of 10.

Mathematics

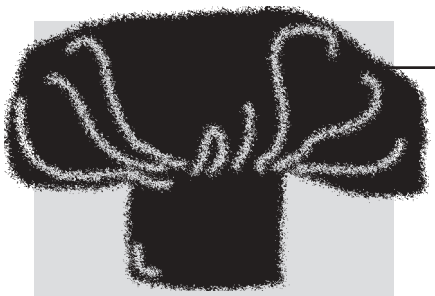
Number, Number Sense and Operations
(Grade 5)

Benchmark B:
Compare, order and convert among fractions, decimals and percents.

Benchmark F:
Apply number system properties when performing computations.

Benchmark G:
Apply and explain the use of prime factorizations, common factors and common multiples in problem situations.

Benchmark I:
Use a variety of strategies including proportional reasoning to estimate, compute, solve and explain solutions to problems involving integers, fractions, decimals and percents.



Indicators:

Meaning of Operations

6. Represent and compare numbers less than 0 by extending the number line and using familiar applications; e.g., temperature, owing money.
7. Use commutative, associative, distributive, identity and inverse properties to simplify and perform computations.
8. Identify and use relationships between operations to solve problems.

Materials

- Copies of the handout (included)
- Pencil
- Calculator (at the teacher's discretion)

.

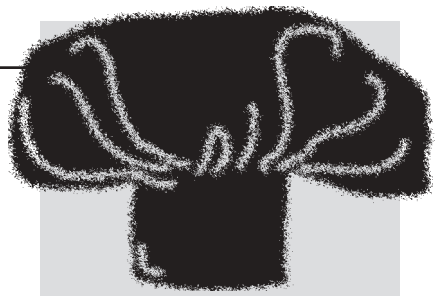
Procedure

Note: Give the students an explanation of what fixed costs means.

1. Hand out the Cyd's Corner Café student worksheet.
2. Explain the concept of fixed costs (costs that stay the same over a period of time) to the students.
3. Explain that restaurants use a standard formula of charging three times the cost of a meal, which covers operating costs and enables them to make a profit.
4. Have the students complete the worksheet.

Evaluation

Use the worksheet results to evaluate student comprehension.



Answer Page : Cyd's Corner Café

Question 1:

Rent = $600/30 = $20
Salaries = 2 employees at $50 = $100
Utilities = $15
Cost of food = 25 meals at $2 = $50
Money made from meals sold = 25 meals at $6 = $150

Total Costs
$20 + $100 + $15 + $50 = $185

$185 (total costs) - $150 (money made) = - $35
Cyd's Corner Café lost $35

Question 2:

Rent = $600/30 = $20
Salaries = 2 employees at $50 = $100
Utilities = $15
Cost of food = 35 meals at $2 = $70
Money made from meals sold = 35 meals at $6 = $210

Total Costs
$20 + $100 + $15 + $70 = $205

$210 (money made) - $205 (total costs) = $5
Cyd's Corner Café made $5

Question 3:

Rent = $600/30 = $20
Salaries = 2 employees at $50 = $100
Utilities = $15
Cost of food = 50 meals at $2 = $100
Money made from meals sold = 50 meals at $6 = $300

Total Costs
$20 + $100 + $15 + $100 = $235

$300 (money made) - $235 (total costs) = $65
Cyd's Corner Café made $65

Challenge Question:

Cyd's Corner Café would have to sell 54 hamburger meals to make a 24 percent profit for one day.

Cyd's Corner Café

Scenario: Cyd's Corner Café, a hamburger stand, is only open Monday through Friday from 11 a.m. to 7 p.m. How many hamburger meals does the stand have to sell to at least break even?

Fixed Costs:

1. Rent = $600 per month.
2. Salaries = $50 per employee, per day. Cyd's Corner Café has two employees.
3. Utilities = $15 per day.
4. Cost of meal = $2 per meal.

1. Calculating rent for a 30-day month, if Cyd's Corner Café sold 25 hamburger meals for the day, it:
   a. lost money
   b. broke even
   c. made a profit

   Show how you arrived at your answer.

2. Calculating rent for a 30-day month, if Cyd's Corner Café sold 35 hamburger meals for the day, it:
   d. lost money
   e. broke even
   f. made a profit

   Show how you arrived at your answer.

3. Calculating rent for a 30-day month, if Cyd's Corner Café sold 50 hamburger meals for the day, it:
   g. lost money
   h. broke even
   i. made a profit

   Show how you arrived at your answer.

Challenge Question:
Calculating rent for a 30-day month, how many hamburger meals would Cyd's Corner Café have to sell to make a 25 percent profit for one day?

Root Beer Floats : States of Matter

Objectives

- Students will follow the directions in a recipe.
- Students will successfully measure ingredients.
- Students will discover what chemical and physical changes occur when ice cream is added to root beer.

Ohio Academic Content Standards

Science

Physical Sciences

Benchmark A:
Compare the characteristics of simple physical and chemical changes.

Indicator:
Nature of Matter
2. Identify characteristics of a simple chemical change. When a new material is made by combining two or more materials, it has chemical properties that are different from the original materials.

Benchmark B:
Identify and describe the physical properties of matter in its various states.

Indicator:
Nature of Matter
4. Explain that matter has different states (solid, liquid, gas) and that each state has distinct physical changes.

Overview of Lesson

The focus of this lesson is to make root beer floats and learn about the states of matter.

Goal

Students will discover the differences between a solid, a liquid and a gas.

Materials

- Measuring cup
- Root beer
- Vanilla ice cream
- Ice cream scoop
- Plastic cups

Procedure

1. Have the students measure ½ cup of root beer and pour it into cup.
2. Next they should add two scoops of ice cream.
3. Have them slowly add more root beer to the cup and observe what happens.
4. What is produced? Is this a physical or chemical change? (It is a chemical change, because a new substance was formed and cannot easily be separated.)
5. On a separate sheet of paper, have the students draw and label the solid, liquid and gas produced when making the root beer float. Have the students also write a brief explanation as to what has occurred and why.

Note:
Ice cream = solid
Root beer = liquid
Air bubbles = gas

Evaluation

Evaluate drawings and explanations. Use the included rubric for evaluation.

Rubric for Root Beer Floats: States of Matter

CATEGORY	4	3	2	1
Strategy/ Procedures	Typically uses an efficient and effective strategy to solve the problem(s).	Typically uses an effective strategy to solve the problem(s).	Sometimes uses an effective strategy to solve problems, but does not do it consistently.	Rarely uses an effective strategy to solve problems.
Mathematical and Scientific Concepts	Explanation shows complete understanding of the concepts used to solve the problem(s).	Explanation shows substantial understanding of the concepts used to solve the problem(s).	Explanation shows some understanding of the concepts needed to solve the problem(s).	Explanation shows very limited understanding of the underlying concepts needed to solve the problem(s) OR is not written.
Mathematical and Scientific Reasoning	Uses complex and refined reasoning.	Uses effective reasoning.	Shows some evidence of reasoning.	Shows little evidence of reasoning.
Neatness, Organization, Grammar and Spelling	The work is presented in a neat, clear, organized fashion that is easy to read.	The work is presented in a neat and organized fashion that is usually easy to read. Grammar and spelling are generally correct.	The work is presented in an organized fashion but may be hard to read at times. There are some grammar and spelling errors.	The work appears sloppy and unorganized. It is hard to know what information goes together. Grammar and spelling are poor.

Homemade Ice Cream Challenge

Objectives

- Students will convert temperatures from Celsius to Fahrenheit.
- Students will add fractions.
- Students will be introduced to percentages.
- Students will be introduced to how freezing affects food.
- Students will determine if making ice cream is a chemical or physical change.

Overview of Lesson

This lesson teaches students about chemical and physical changes and the addition of fractions.

Goal

Students will convert between Celsius and Fahrenheit, add fractions and learn about percentages. They also will understand how temperature affects food.

Ohio Academic Content Standards

Mathematics

Measurement (Grade 5)

Benchmark B:
Convert units of length, area, volume, mass and time within the same measurement system.

Benchmark E:
Use problem-solving techniques and technology as needed to solve problems involving length, weight, perimeter, area, volume, time and temperature.

Indicator:
5. Make conversions within the same measurement system while performing computations.

Science

Physical Science (Grade 6)

Benchmark A:
Relate uses, properties and chemical processes to the behavior and/or arrangement of the small particles that compose matter.

Indicator:
3. Describe that in a physical change (e.g., state, shape and size) the chemical properties of a substance remain unchanged.

Science

Physical Science (Grade 4)

Benchmark A:
Compare the characteristics of simple physical and chemical changes.

Indicator:
2. Identify characteristics of a simple physical change (e.g., heating or cooling can change water from one state to another and the change is reversible).

Materials

- Ingredients listed in ice cream recipe

Procedure

1. Read scenario to students.
2. Have students make temperature conversions on worksheet.
3. Have students make recipe adjustments on worksheet.

Evaluation

Note: At the teacher's discretion, older students may use the formulas given on the worksheets to convert temperatures from Celsius to Fahrenheit, and the reverse. For younger students, the teacher may go to the following Web sites for temperature converters: **www.image-ination.com/test_maker/convert.html**

Answer Page : The Homemade Ice Cream Challenge

Scenario:

The Corner Ice Cream Parlor regularly purchases its ice cream from a dairy company. One afternoon, several students asked the owner, Carl, if he would help them experiment with making homemade ice cream. Carl agreed, and with the help of the students, he immediately set out looking for a recipe and collecting the ingredients and necessary equipment.

Carl and the students found easy recipes for making the ice cream. What surprised them was the ingredient of rock salt. The freezing point to make ice cream is lower than 0 C (32 F) because there is sugar in the ice cream mixture. Rock salt is used to lower the temperature below freezing so that the mixture will freeze.

Converting temperature — use the following temperatures for practice

The temperature of the ice cream mixture can be controlled by the amount and ratio of rock salt and ice used. The more rock salt added to the ice, the lower the temperature. In the chart below are ice and rock salt concentrations and the temperatures. Convert the given temperatures to either Fahrenheit or Celsius.

Answers for pg. 78 — converting temperatures

Celsius Temperature	Fahrenheit Temperature
23.9	75 F
9 C	48.2 F
15.6 C	60 F
37 C	98.6 F
51.7 C	125 F
99 C	210.2 F

To convert from F (Fahrenheit) to C (Celsius), use this formula.
C = 5/9 x (F – 32)

Example:
Solve for F = 55 degrees
C = 5/9 x (55 – 32)
C = 5/9 x 23
C = 115/9
C = 12.8

To convert C (Celsius) from to F (Fahrenheit), use this formula.
F = (1.8 x C) + 32

Example:
Solve for C = 20 degrees
F = (1.8 x 20) + 32
F = 36 + 32
F = 68

Making Ice Cream

The recipe makes enough ice cream for two students. However, there are five students helping Carl. To make enough ice cream for everybody, the students will have to triple the recipe.

Ingredients (for two students)	Ingredients x 3
1 tablespoon sugar	2 tablespoons sugar
1/2 teaspoon vanilla	1-1/2 teaspoons vanilla
1/2 cup milk	1-1/2 cups milk

Plastic Bag Procedure

1. Have the students mix ingredients in a small plastic back that zips closed (the heavy-duty, freezer type).
2. Secure the bag and place it in a larger bag of the same type.
3. Fill the large bag half full of ice, surrounding the small bag.
4. Add 6 tablespoons of salt to the ice.
5. Close the large bag and shake it for five to 10 minutes.
6. The students can enjoy their own serving of ice cream! Add toppings if desired.

Coffee Can Procedure

This procedure uses a different recipe and method for making ice cream.

Ingredients:

2 cups whole milk (or add cream or powdered milk to 2 percent or skim milk)
½ cup sugar
1 teaspoon vanilla
¾ cup rock, pickling or plain salt (larger crystals last longer)
Crushed ice
2 coffee cans, one at least one inch in diameter larger than the other

If desired, flavorings such as chocolate or fruit syrups or Kool-Aid powder may be added.

Preparation:

1. Mix the first four ingredients and stir well.
2. Place the smaller coffee can inside the larger can and put in enough ice, alternating with layers of rock salt two or three times, to completely pack the space between the two cans.
3. Tape or tie the lid down firmly on the smaller container.
4. Seal the larger can well and then roll it back and forth between two students for from 10 to 20 minutes, or one person can shake the can. You can also make drain holes in the bottom of the larger container, punching them with a nail, but it can be messy if the can will be passed back and forth.
5. To check for doneness, take off the lid and stir the mixture. If it is not frozen solid enough, drain the water caused by melting ice, repack and shake or roll again.

The Homemade Ice Cream Challenge

Scenario:

The Corner Ice Cream Parlor regularly purchases their ice cream from a dairy company. One afternoon, several students asked the owner, Carl, if he would help them experiment by making homemade ice cream. Carl agreed, and with the help of the students, immediately set out looking for a recipe, collecting the ingredients and equipment needed to make homemade ice cream.

Carl and the students found easy recipes for making the ice cream. What surprised them was the ingredient of rock salt. The freezing point to make ice cream is lower than 0 C (32 F) because there is sugar in the ice cream mixture. Rock salt is used to lower the temperature below freezing so that the mixture will freeze and make ice cream.

The temperature of the ice cream mixture can be controlled by the amount and ratio of rock salt and ice used. The more rock salt added to the ice, the lower the temperature. In the chart below are ice and rock salt concentrations and the temperatures. Convert the given temperatures to either Fahrenheit or Celsius.

Converting temperature – use the following temperatures for practice

Celsius Temperature	Fahrenheit Temperature
	75 F
9 C	
	60 F
37 C	
	125 F
99 C	

To convert from F (Fahrenheit) to C (Celsius), use this formula.
C = 5/9 x (F – 32)

Example:
Solve for F = 55 degrees
C = 5/9 x (55 – 32)
C = 5/9 x 23
C = 115/9
C = 12.8

To convert C (Celsius) from to F (Fahrenheit), use this formula.
F = (1.8 x C) + 32

Example:
Solve for C = 20 degrees
F = (1.8 x 20) + 32
F = 36 + 32
F = 68

The recipe makes enough ice cream for two students. However, there are five students helping Carl. To make enough ice cream for everybody, the students will have to triple the recipe.

Ingredients (for two students)	Ingredients x 3
1 tablespoon sugar	
1/2 teaspoon vanilla	
1/2 cup milk	

Gas Laws

The gas laws started to evolve in 1643 with the invention of the barometer. This is well before the birth of modern atomic theory. Some early inventions include the following.

- The barometer is an instrument that determines the pressure of the atmosphere. It is used to assist in determining probable weather changes. Evangelisto Torricelli was Galileo's secretary. He found out that mercury was 13 times denser than water. The relationship between the water and the mercury showed the relationship between volume and pressure and therefore could be used to gauge weather changes.
- Robert Boyle discovered that the greater the pressure, the smaller the volume. This is known as Boyle's Law and is important in applications such as the flight of a blimp.
- In 1702, Amontons discovered a method to measure the change in temperature depending on the change in pressure.
- The modern kinetic molecular theory of gases essentially started with Bernoulli's suggestion in 1734 that the pressure exerted by a gas on the walls of its container is the sum of the many collisions by individual molecules, all moving independently of each other. Bernoulli derived the basic laws for the theory of gases. (**web.fccj.org/~ethall/gaslaw/gaslaw.htm**)
- Galileo invented the first thermometer in 1592. It was based on the expansion and contraction of air.
- German physicist Gabriel Fahrenheit developed a thermometer in 1714. The Fahrenheit temperature was named after him.
- Jacques Charles discovered Charles' Law, which states: This law explains the relationship between volume (v) and temperature (t) if pressure and amount are held constant (k).
    - If the volume of a container is increased, the temperature increases.
    - If the volume of a container is decreased, the temperature decreases.

Over the years many other laws have been discovered.

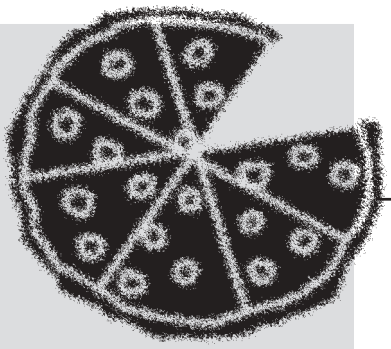
Notes

Math and Science

Gumbo

Pizza Shop

www.pbs4549.org/gumbo



Parts of a Set

Objectives

- The students will sort cereal pieces according to their colors.
- The students will graph the quantities of each color using a line plot.
- The students will write fractions as part of a set.

Overview of Lesson

Using colorful cereal, students learn about different parts of a whole.

Goal

Students will discover how to write a fraction as a part of a set.

Ohio Academic Content Standards

Mathematics

Data Analysis and Probability Standard

Benchmark A:
Gather and organize data from surveys and classroom experiments, including data collected over a period of time.

Benchmark B:
Read and interpret tables, charts, graphs (bar, picture, line, line plot) and timelines as sources of information, identify main idea, draw conclusions and make predictions.

Benchmark G:
Identify and represent possible outcomes, such as arrangements of a set of up to four members and possible combinations from several sets, each containing two or three members.

Benchmark H:
Use the set of possible outcomes to describe and predict events.

Indicators
Data Collection
Grade 3
4. Support a conclusion or prediction orally and in writing, using information in a table or graph.
6. Translate information freely among charts, tables, line plots, picture graphs and bar graphs; e.g., create a bar graph from the information in a chart.

Grade 4
2. Represent and interpret data using tables, bar graphs, line plots and line graphs.

Mathematics

Number, Number Sense and Operations

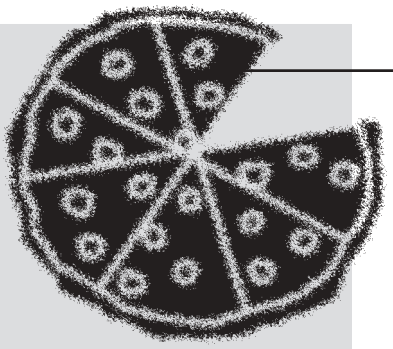
Benchmark B:
Recognize and generate equivalent representations for whole numbers, fractions and decimals.

Indicators
Number and Number Systems
Grade 3
7. Recognize and use decimal and fraction concepts and notations as related ways of representing parts of a whole or a set; e.g., 3 of 10 marbles are red can also be described as 3/10 and 3 tenths are red.

Meaning of Operations
8. Model, represent and explain multiplication; e.g., repeated addition, skip counting, rectangular arrays and area model. For example:
   a. Use conventional mathematical symbols to write equations for word problems involving multiplication.
   b. Understand that, unlike addition and subtraction, the factors in multiplication and division may have different units; e.g., 3 boxes of 5 cookies each.

Grade 4
Number and Number Systems
5. Use models and points of reference to compare commonly used fractions.

Computation and Estimation
10. Use physical models, visual representations and paper and pencil to add and subtract decimals and commonly used fractions with like denominators.

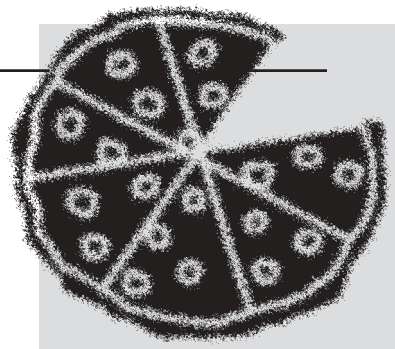


Materials

- Colorful circle-shaped cereal, such as Froot Loops
- Graph paper
- Paper
- Pencil

Procedure

1. Give each student ½ cup of the cereal. Have the students count their cereal pieces and then write down that number. The total number is the denominator – the bottom number of a fraction. Therefore, each fraction that they write will have the same denominator.
2. The students then sort the cereal pieces according to color. Ask them to graph how many pieces are red, green, etc. These numbers will be the numerators of the fractions.
3. After graphing the colors, they can make a line plot using the information. Remind them to show a title and to label the axes.
4. Above each bar, write the fraction showing the parts (colors) of each set.



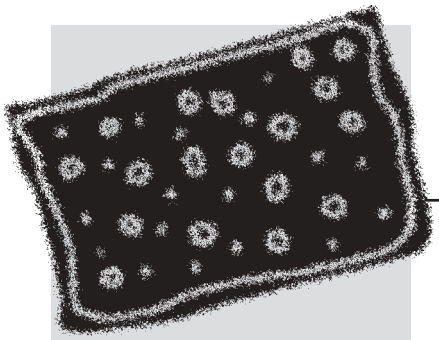
Evaluation

Information written in the graph and on the line plot should match the fraction. This should be done with accuracy.

Use the included rubric to assist with evaluation.

Rubric: Parts of a Set

CATEGORY	4	3	2	1
Title	The title is creative and clearly relates to the problem being graphed (includes dependent and independent variables). It is printed at the top of the graph.	The title clearly relates to the problem being graphed (includes dependent and independent variables) and is printed at the top of the graph.	A title is present at the top of the graph.	A title is not present.
Labeling of X axis	The X axis has a clear, neat label that describes the units used for the independent variable (e.g, days, months, participants' names).	The X axis has a clear label that describes the units used for the independent variable.	The X axis has a label.	The X axis is not labeled.
Labeling of Y axis	The Y axis has a clear, neat label that describes the units and the dependent variable (e.g, percent of dog food eaten; degree of satisfaction).	The Y axis has a clear label that describes the units and the dependent variable (e.g, percent of dog food eaten; degree of satisfaction).	The Y axis has a label.	The Y axis is not labeled.
Accuracy of Plot	All points are plotted correctly and are easy to see. A ruler is used to neatly connect the points or make the bars, if not using a computerized graphing program.	All points are plotted correctly and are easy to see.	All points are plotted correctly.	Points are not plotted correctly OR extra points were included.



Area of a Rectangle and a Square

Objectives

- Students will draw an array (a picture arranged in rows and columns) for a rectangular pizza and a square pizza.
- Students will construct an array using tiles to show the area of two differently shaped pizzas.
- Students will calculate the area of a rectangle and the area of a square using the formula length times width, or side times side.

  Formulas:
  L = length
  W = width
  S = sides
  A = Area
  L • W = area of a rectangle
  S^2 or S • S = area of a square

Overview of Lesson

Students will learn how to determine the area of a rectangular pizza and a square pizza.

Goal

Students will calculate the area of a rectangular pizza and a square pizza to see which one has more area.

Ohio Academic Content Standards

Mathematics

Measurement (Grades 3-4)

Benchmark A:
Select appropriate units for perimeter, area, weight, volume (capacity), time and temperature using objects of uniform size; U.S. customary units; e.g., mile, square inch, cubic inch, second, degree Fahrenheit and other units as appropriate; metric units; e.g., millimeter, kilometer, square centimeter, kilogram, cubic centimeter, degree Celsius and other units as appropriate.

Benchmark D:
Identify appropriate tools and apply counting techniques for measuring side lengths, perimeter and area of squares, rectangles and simple irregular two-dimensional shapes, volume of rectangular prisms and time and temperature.

Indicators
Use Measurement Techniques and Tools
6. Use appropriate measurement tools and techniques to construct a figure or approximate an amount of specified length, weight or volume (capacity); e.g., construct a rectangle with a length of 2-1/2 inches and width of 3 inches.

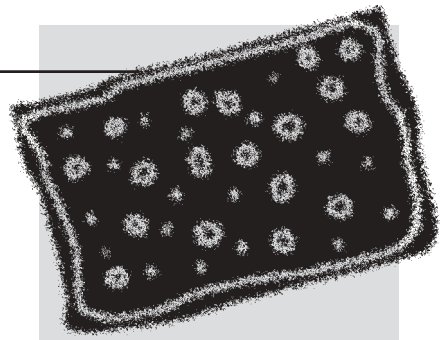
7. Make estimates for perimeter, area and volume using links, tiles, cubes and other models.

Materials

- Color tiles
- Connecting tubes
- 1-centimeter graph paper
- Paper
- Pencil

Procedure

1. Have the students guess how many tiles or connecting cubes it would take to cover the surface of arrays that are 14" by 12" and 12" by 12".
2. Give the students tiles and connecting cubes to show the 14" by 12" array and the 12" by 12" array. Count how many of each it took to make the arrays with the given dimensions.



3. Explain that the students can use graph paper to show the same information. Give the children graph paper and have them draw an array representing a pizza that is 14" by 12" and 12" by 12". Then as a class, count aloud the total number of square units found in each array. Does the amount of square units equal the amount of tiles or connecting cubes used?
4. Instruct the students to color in the array that they have made and tell them that the colored surface is called the area.
5. Ask the students which pizza is larger, and why. Have them write out their response after the class discussion.

Evaluation

Students will be assessed on their ability to determine the area of a shape by covering it with tiles or connecting cubes and then convert that information to grid paper.

Use the included rubric to assist with evaluating the writing and mathematics.

Rubric: Area of a Rectangle and a Square

CATEGORY	4	3	2	1
Strategy/ Procedures	Typically uses an efficient and effective strategy to solve the problem(s).	Typically uses an effective strategy to solve the problem(s).	Sometimes uses an effective strategy to solve problems, but does not do it consistently.	Rarely uses an effective strategy to solve problems.
Mathematical Concepts	Explanation shows complete understanding of the mathematical concepts used to solve the problem(s).	Explanation shows substantial understanding of the mathematical concepts used to solve the problem(s).	Explanation shows some understanding of the mathematical concepts needed to solve the problem(s).	Explanation shows very limited understanding of the underlying concepts needed to solve the problem(s) OR is not written.
Mathematical Reasoning		Uses effective mathematical reasoning.	Shows some evidence of mathematical reasoning.	Shows little evidence of mathematical reasoning.
Neatness, Organization, Grammar and Spelling	The work is presented in a neat, clear, organized fashion that is easy to read.	The work is presented in a neat and organized fashion that is usually easy to read. Grammar and spelling are generally correct.	The work is presented in an organized fashion but may be hard to read at times. There are some grammar and spelling errors.	The work appears sloppy and unorganized. It is hard to know what information goes together. Grammar and spelling are poor.

Data Analysis and Probability

Objective
Students will use a tree diagram to provide possible combinations.

Ohio Academic Content Standards
Mathematics
Data Analysis and Probability

Benchmark H:
Find all possible outcomes of simple experiments or problem-solving situations, using methods such as lists, arrays and tree diagrams.

Indicators
Data Collection
4. Determine appropriate data to be collected to answer questions posed by students or teacher, collect and display data and clearly communicate findings.
5. Modify initial conclusions, propose and justify new interpretations and predictions as additional data are collected.

Probability
7. List and explain all possible outcomes in a given situation.

Overview of Lesson
Using data analysis and probability, students track food inventory and look at options available for creating special offers.

Goal
Students will work in groups and use a tree diagram to determine how many combinations can be created from a given set of selections.

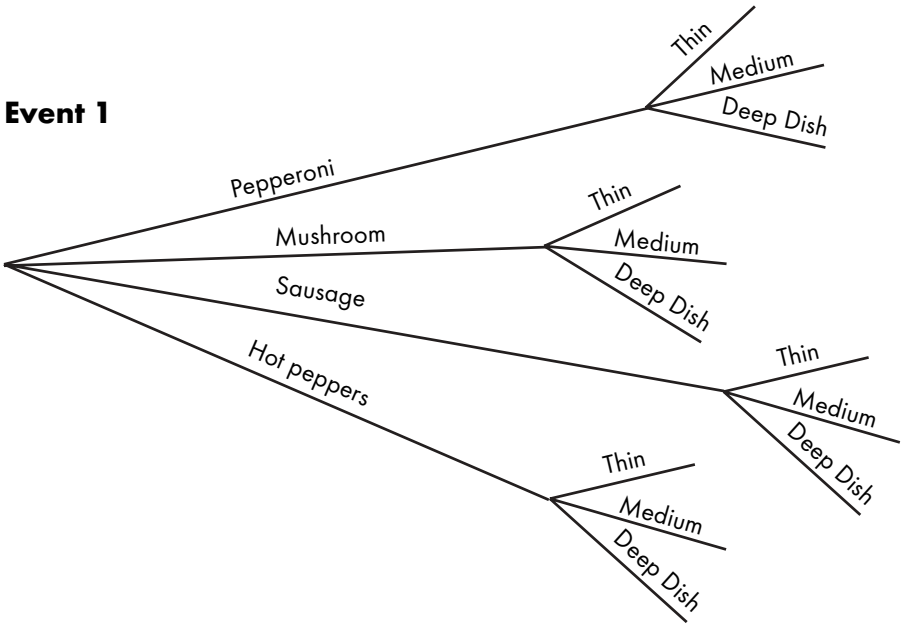
Materials
- Paper
- Pencils or pens

Procedure
Scenario: The manager must determine the appropriate inventory of staples to maintain for a pizzeria. Most restaurants and cafeterias use a spreadsheet program that enables them to track food movement. This helps them recognize trends such as which items are most popular and what specials they might offer.

1. Survey students to decide which pizza options for toppings and crusts should be used to create the classroom tree diagram. Make a list of the suggestions and then take a vote of the top four topping choices and top three types of crust. This part of the exercise helps students get enthused about the activity.
2. Ask the students to determine how many combinations can be created from the selections. Allow them to offer suggestions on how to proceed.
3. Divide the students into small groups to solve the problem. After 15 to 20 minutes, check on their progress. Facilitate a discussion on processes employed to solve the problem.
4. Suggest that a tree diagram could be used to solve the problem. Demonstrate how to make a tree diagram.
5. Ask students to share observations about this procedure. Ask if there is a way students could anticipate how many choices there would be. How many choices would there be if two more toppings were available?

Tree Diagram Example

4 toppings – pepperoni, mushroom, sausage, hot peppers
3 crusts – thin, medium, deep dish



Sample Space (the number of possibilities)	
1. Pepperoni – thin	7. Sausage – thin
2. Pepperoni – medium	8. Sausage – medium
3. Pepperoni – deep dish	9. Sausage – deep dish
4. Mushroom – thin	10. Hot peppers – thin
5. Mushroom – medium	11. Hot peppers – medium
6. Mushroom – deep dish	12. Hot peppers – deep dish

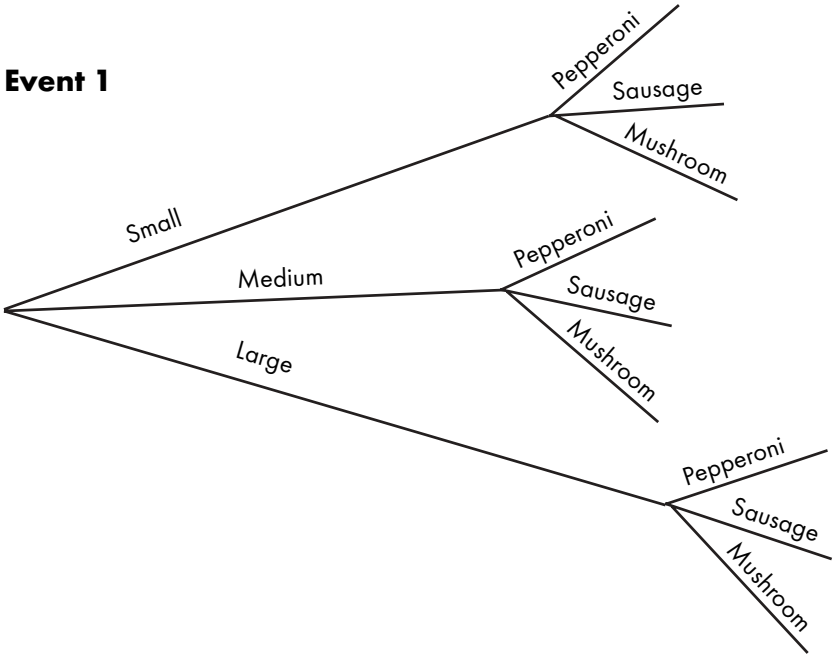
4 x 3 = 12 possible pizzas

Evaluation

Working in small groups, the students can use the tree diagram to solve a new problem. This time, they are working with three topping choices and three sizes of pizza. The teacher might consider whether or not the students could solve the problem without a blank tree. The fourth grade teacher could determine whether or not the students need a partial tree to complete the task. Comprehension by 75 to 80 percent of the students indicates that the lesson was successful.

Answer (to evaluation question)

Sizes – small, medium, large
Toppings – pepperoni, sausage, mushroom



1. Small – pepperoni	6. Large – mushroom
2. Medium – pepperoni	7. Small – sausage
3. Large – pepperoni	8. Medium – sausage
4. Small – mushroom	9. Large – sausage
5. Medium – mushroom	

3 x 3 = 9 possible pizzas

Equivalent Fractions and Fraction Bars

Objectives

- Students will make a fraction plate and use it as a physical model to show equivalent fractions.
- Students will compare fractions.

Ohio Academic Content Standards

Mathematics

Number, Number Sense and Operations Standard

Benchmark D:
Use models, points of reference and equivalent forms of commonly used fractions to judge the size of fractions and to compare, describe and order them.

Indicators
Number and Number Systems
Grade 3
5. Represent fractions and mixed numbers using works, numerals and physical models.
6. Compare and order commonly used fractions and mixed numbers using number lines, models (such as fraction circles or bars), points of reference (such as more or less than $\frac{1}{2}$) and equivalent forms using physical or visual models.

Computation and Estimation
Grade 4
10. Use physical models, visual representations, paper and pencil to add and subtract decimals and commonly used fractions with like denominators.

Overview of Lesson

Using two different methods, students will learn about equivalent fractions.

Goal

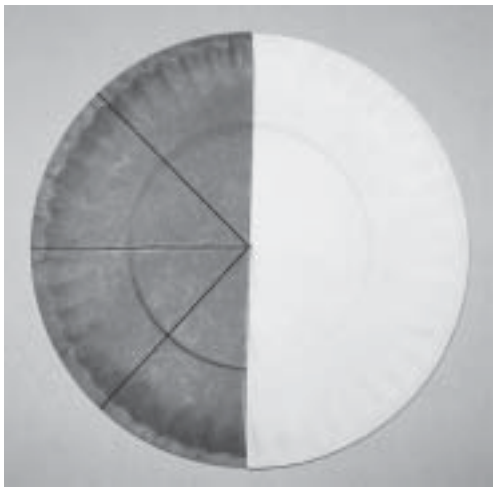
Students will discover that $\frac{1}{2} = \frac{2}{4} = \frac{4}{8}$.

Materials

- Two paper plates per student
- Blue strips of paper, 2 x 8 inches
- Orange strips of paper, 2 x 8 inches
- Pencils
- Markers, crayons, etc.

Procedure

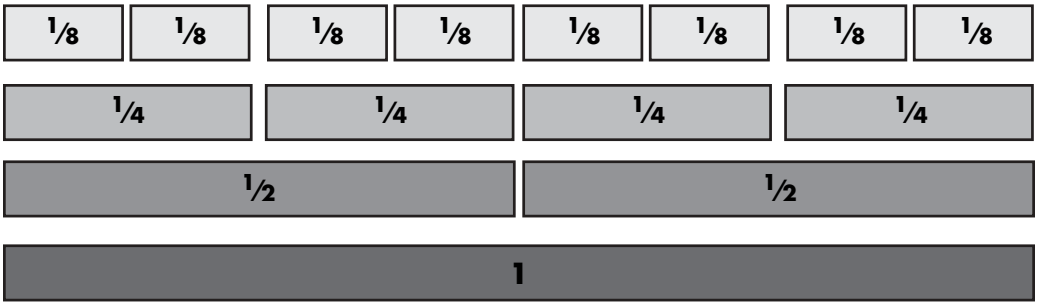
1. Provide each student with two paper plates, and have them color one of them. Have them make a cut on both plates just to the middle. Slide one cut inside the other.
2. Have students rotate the plates so that one half of each plate is showing. Draw a line down the middle of the plate using the $\frac{1}{2}$ mark that was dialed.
3. Then draw another line on the colored plate cutting the half in half.
4. Finally, on the colored plate, draw two more lines cutting the shaded $\frac{1}{2}$ into 4 equal pieces (making it really into eighths).
5. Now when students dial the $\frac{1}{2}$ they will readily see that it is equivalent to $\frac{2}{4}$ or $\frac{4}{8}$.



Another method to demonstrate equivalent fractions is with strips of colored paper.

1. Leave the blue strip of paper whole. Label it "1."
2. Cut one orange strip in half. Label each piece "1/2." Place the two pieces above the blue whole strip, showing that two halves equal one whole.
3. Cut the next strip of orange paper in half twice to make fourths. Place these pieces above the halves. This shows that 2/4 = 1/2, and 4/4 = 2/2 = 1.
4. Finally cut the last strip of orange paper into eighths. Place these pieces above the fourths. This shows that 1/4 = 2/8; 2/4 = 4/8 = 1/2; 8/8 = 1, etc.

Example: Fraction Bars



Evaluation

Using the paper plate and fraction bars, write the equivalent fractions for 1/4, 1/2 and 3/4.

Equivalent Fractions Model

Objectives

- The students will create a fraction square.
- The students will use the fraction square to demonstrate addition of fractions.
- The students will use the fraction square to demonstrate subtraction of fractions.

Ohio Academic Content Standards

Mathematics

Number, Number Sense and Operations

Benchmark D:
Use models and pictures to relate concepts of ratio, proportion and percent.

Benchmark I:
Using a variety of strategies, including proportional reasoning, to estimate, compute, solve and explain solutions to problems involving integers, fractions, decimals and percents.

Indicators
Grade 5
Number and Number Systems

1. Use models and visual representations to develop the concept of ratio as part-to-part and part-to-whole, and the concept of percent as part-to-whole.

2. Use various forms of the number 1 to demonstrate the equivalence of fractions; e.g., $^{18}/_{24} = {}^{9}/_{12} \times {}^{2}/_{2} = {}^{3}/_{4} \times {}^{6}/_{6}$.

Grade 6
Number and Number Systems

5. Use models and pictures to relate concepts of ratio, proportion and percent, including percents less than one and greater than 100.

Overview of Lesson

Students practice the addition and subtraction of fractions by making fraction squares out of a folded piece of paper.

Goal

Students will learn to add and subtract fractions with the aid of a fraction square.

Materials

- Construction paper or tag board cut into 8-inch-by-8-inch squares

Procedure

Steps for making a fraction tool

1. Start with a piece of paper, thin cardboard or tag board. Cut it into 8 inches square.
2. Fold all four corners into the center so that you have four triangles with the apexes pointing into the center.
3. Mark two of the folded triangles as $^{1}/_{4}$.

Step 1

Step 2

Step 3

4. On the third folded triangle make a perpendicular cut from the apex of the triangle to the fold.
5. Mark the two subsections of this triangle three as 1/8.
6. On the fourth triangle make a perpendicular cut from the apex of the triangle to the fold. Next, divide each of the two sections with another partial cut (if you cut too far, you will cut the sections off). You should now have four sections in the fourth triangle.
7. Mark the four subsections of this triangle as 1/16.

Step 4

Step 5

Step 6

Step 7

Day 1

1. Using the fraction tool, begin with simple computations:
   a. 1/4 + 1/4 = ? Have the students lay down the identified flaps to determine the answer. Answer: 2/4 = 1/2.
   b. 1/4 + 1/8 = ? How can that be expressed so that denominators are the same? Answer: Another way of saying 1/4 is 2/8, so 2/8 + 1/8 = 3/8.
2. Offer progressively more difficult problems, ultimately leading to students creating equations for the class to solve.
3. Based upon students' progress and understanding, write 10 addition problems on the board for students to copy and solve using their fraction square. You may also use the included student worksheet.

Day 2

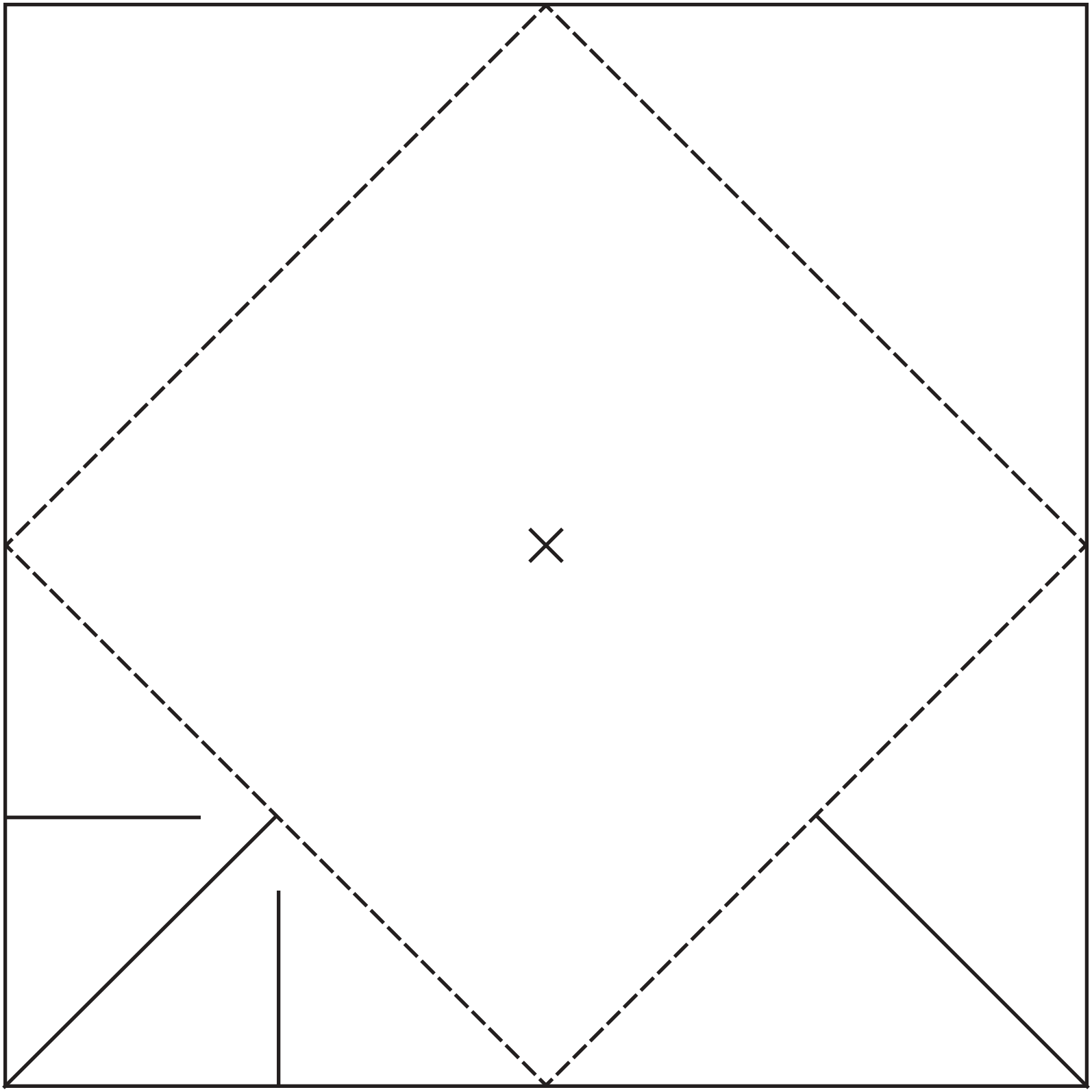
1. Follow the same procedures as above, but subtract fractions with like denominators.
2. Move onto a higher level by having the students subtract fractions with unlike denominators (example: 1/4 – 1/8 = ?, 2/4 – 4/16 = ?).
3. Based upon students' progress and understanding, write 10 subtraction problems on the board for them to copy and solve using their fraction square. You may also use the included student worksheet.
4. Have the students use the tool to solve the equations on the student worksheet.

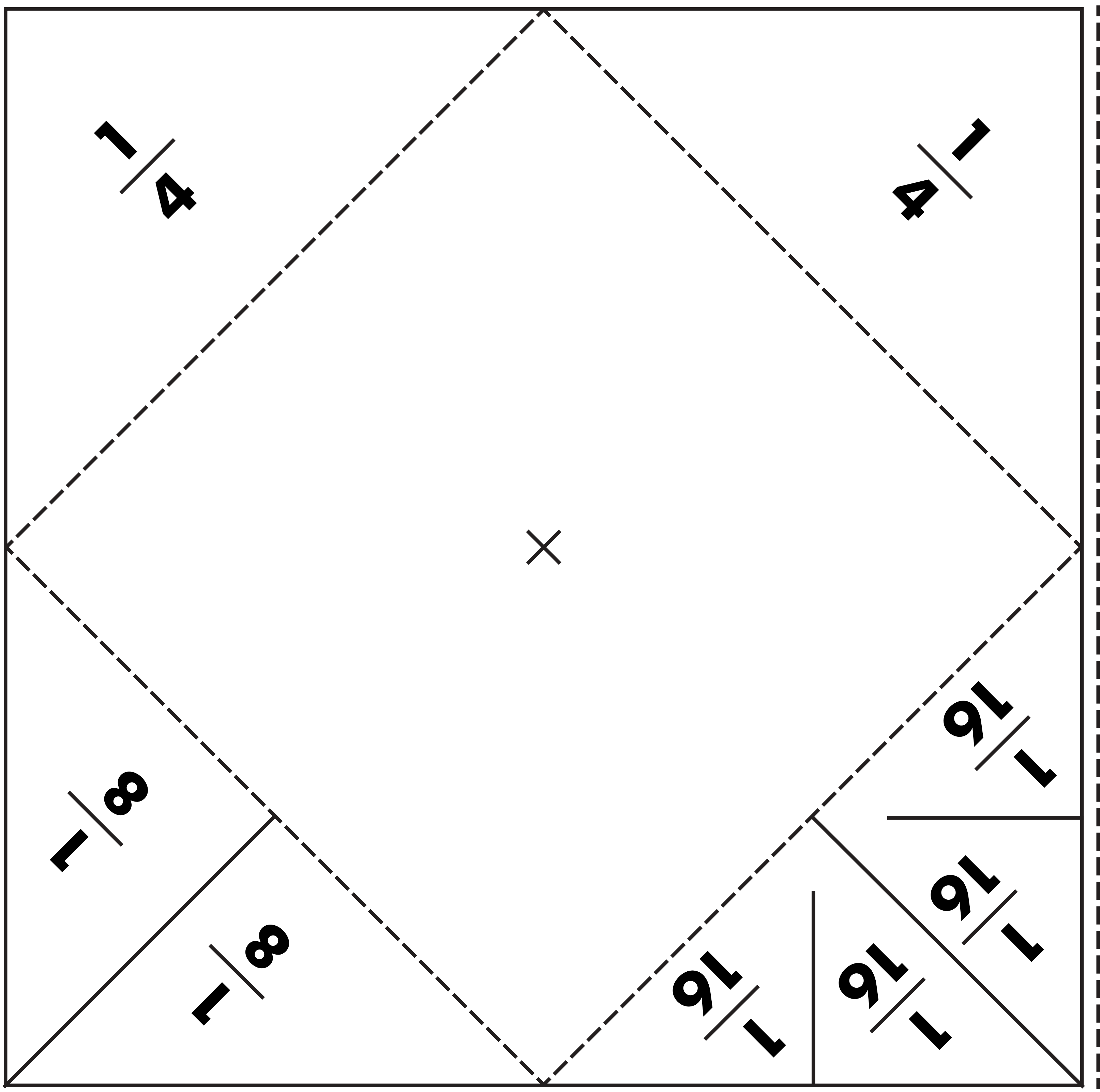
Evaluation

Use the number of correct problems divided by 10. Introduce the students to percentage, e.g., 8/10 = 80 percent.

Instructions:

1. Solid lines indicate where the paper should be cut. Dotted lines are where the paper is folded.
2. Cut off the top where these instructions are printed, and save the instructions for reference.
3. Fold the four corners of the remaining square into the center. The tip of each corner should touch the X.
4. With the four corners folded, you should see the fractions printed on the opposite side.
5. Fold the corners back and make cuts along the remaining lines.
    A. For the 1/8 section, cut the line down the center to the fold.
    B. For the 1/16 section, cut the line down the center to the fold and then cut the remaining two lines just as far as the printed lines indicate. Be careful not to cut too far.
6. Now you are ready to use the fraction tool.




1/4
1/4
1/8
1/8
1/16
1/16
1/16
1/16

Addition

1. $\frac{1}{4} + \frac{1}{4} =$

2. $\frac{1}{4} + \frac{1}{8} =$

3. $\frac{1}{4} + \frac{1}{16} =$

4. $\frac{1}{8} + \frac{1}{8} =$

5. $\frac{1}{8} + \frac{1}{16} =$

6. $\frac{1}{16} + \frac{1}{16} =$

7. $\frac{1}{4} + \frac{1}{4} + \frac{1}{8} =$

8. $\frac{1}{4} + \frac{1}{8} + \frac{1}{8} =$

9. $\frac{1}{8} + \frac{1}{8} + \frac{1}{16} =$

10. $\frac{1}{8} + \frac{1}{16} + \frac{1}{16} =$

Subtraction

1. $\frac{1}{4} - \frac{1}{8} =$

2. $\frac{1}{8} - \frac{1}{16}$

3. $\frac{1}{2} - \frac{1}{4} =$

4. $\frac{1}{2} - \frac{1}{8} =$

5. $\frac{1}{2} - \frac{1}{16} =$

6. $\frac{3}{8} - \frac{1}{16} =$

7. $\frac{1}{4} - \frac{1}{16} - \frac{1}{16} =$

8. $\frac{3}{4} - \frac{1}{16} =$

9. $\frac{1}{2} - \frac{1}{8} - \frac{1}{16} =$

10. $\frac{1}{4} - \frac{1}{8} - \frac{1}{8} =$

Area and Perimeter

Area is the size that a surface takes up, measured in square units.

Area of a rectangle = length times width

Area of a square = side times side (s^2)

Area of a triangle = one half times base times height (1/2bh)

Area of a trapezoid = base one plus base 2 divided by 2 times the height $\frac{(b_1 + b_2)}{2} \cdot h$

Area of a circle = pi times radius times radius ($\pi \cdot r^2$)

Perimeter is the distance around the outside of a shape. To find the perimeter, add the measure of all of the sides.

Circumference is the distance around a circle. The circumference of a circle = pi times diameter ($\pi \cdot d$).

Related Books

(courtesy of Illinois Institute of Technology, **www.iit.edu/~smile**)

- *An Introduction to Volume* by Linda James Woods, Harold Washington Elementary School
- *Measurement of Volume* by Richard Murray, Gage Park High School
- *Volume and Surface Area* by Charlotte Goldwater, Kenwood Academy
- *An Introduction to Area and Perimeter* by Edwina R. Justice, Gunsaulus Scholastic Academy
- *An Introduction to Estimation and Measurements* by Christeen Brown, Robert Fulton Elementary
- *Circumferences, Diameters, and Radii* by Dwayne Belle, Fuller School

Fractions

When an object is divided into a number of equal parts, then each part is called a fraction.

There are different ways of writing a fraction. For example, one-half of an object can be written in the following ways:

- Common fraction: ½
- Decimal: 0.5
- Percentage: 50%

Now let us have a closer look at the common fraction:

2 Numerator – Shows how many parts are in the fraction
— the vinculum is the symbol for "divide by"
5 Denominator – Shows how many equal parts are in the whole object

Remember: The denominator can never be zero because you cannot divide by zero.

Fraction Types

There are three different types of fractions:

1. Proper fractions: The numerator is smaller than the denominator.

   For example $\frac{1}{2}$, $\frac{2}{5}$ or $\frac{19}{20}$.

2. Improper fractions: The numerator is greater than or equal to the denominator.

   For example $\frac{5}{5}$ or $\frac{7}{2}$.

3. Mixed fractions: There is a whole number plus a fraction.

   For example $2\frac{1}{5}$ or $123\frac{19}{20}$.

Global Positioning Satellite (GPS)

The Global Positioning System (GPS) is a satellite-based navigation system made up of a network of 24 satellites placed into orbit by the U.S. Department of Defense. GPS was originally intended for military applications, but in the 1980s, the government made the system available for civilian use. GPS works in any weather conditions, anywhere in the world, 24 hours a day. There are no subscription fees or set-up charges to use GPS.
(From the Garmin GPS Web site, **www.garmin.com**)

GPS is funded by and controlled by the U.S. Department of Defense. It provides satellite signals that can be processed in a GPS receiver, enabling the receiver to compute position, velocity and time. Four GPS satellite signals are used to compute positions in three dimensions and the time offset in the receiver clock.

Graphing

Graphs show a **visual representation** of data that has been collected. Samples of the different kinds of graphs are listed below.

Line Plot

A **line plot** indicates the location of data points along a segment of the number line. The following line plot depicts the number of hits made during a baseball game.

Hits from Tia's Team

1	2	3	4	5	6	7	8	9	10	11	12
							X				
							X		X		
							X	X	X		
				X			X	X	X		
			X	X			X	X	X	X	

X = one hit

Pictograph

A **pictograph** uses a repeated picture of a symbol in a bar graph form to represent data. The key tells the value of one symbol.

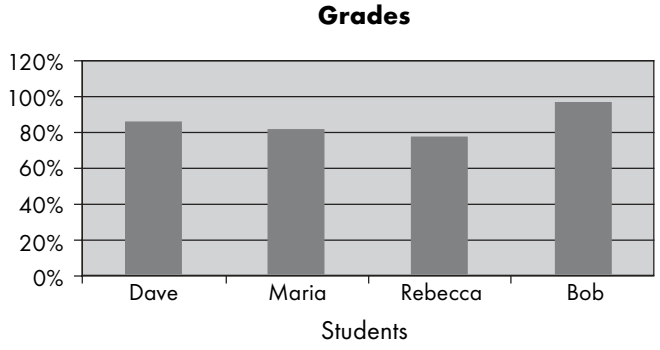
Number of Phone Calls That Tia Received

Monday	☎ ☎ ☎ ☎ ☎
Tuesday	☎ ☎
Wednesday	☎ ☎

☎ = two calls

Bar Graph

A **bar graph** uses parallel bars, either horizontal or vertical, to represent counts for several categories. One bar is used for each category and the length of the bar represents the count for that category.



Stem and Leaf Plot

A **stem and leaf plot** lists exact values in a meaningful array. It is especially useful when the data set covers a range of 25 numbers or more. On a real-number line, the data might appear crowded on a line plot, making it difficult to recover the exact numerical values.

Data set = grams of fat content in cereal:
55, 48, 31, 32, 33, 38, 20, 25, 28, 28, 10, 10, 13, 13, 14, 14, 14, 15, 19, 19, 3, 4, 5, 8, 9

Fat Content

5	5									
4	8									
3	1	2	3	8						
2	0	5	8	8						
1	0	0	3	3	4	4	4	5	9	9
0	3	4	5	8	9					

4 | 8 means 48

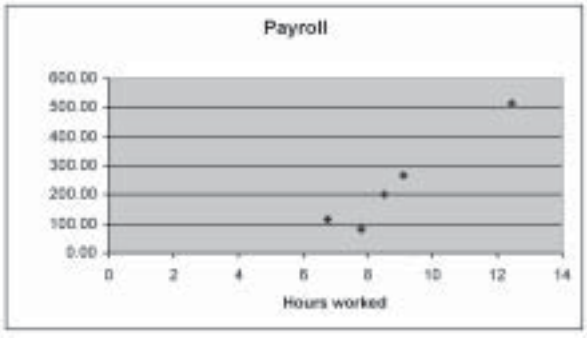
Scatter Plot

A **scatter plot** shows the relationship between paired measurements by plotting each ordered pair on a coordinate grid. The first number of the pair is marked off along the horizontal axis (or the x axis) and the second number is marked off along the vertical axis (or the y axis).

Ordered Pairs:

Hours	Salary
8.5	200.87
9.1	268.81
12.44	514.47
7.8	80.64
6.75	114.65

Salary for Hours Worked



These definitions are from Bereska, C., Bolster, L., & Bolster, C. et.al. (1998). *Exploring Statistics in the Elementary Grades, Book 1*. White Plains, NY: Dale Seymour Publications.

Measurement

The five forms of measurement listed below are those that are most commonly used.

1. **Length:** A measure of an object from one end to the other. This measure is similar to **distance**, which measures the space between points or objects. When you measure the distance around an object, you are finding its perimeter.

2. **Mass:** The amount of matter in an object. Mass is different from **weight**, which measures the force of gravity acting on an object.

3. **Temperature:** The amount of warmness or coldness in an object. The device used to measure temperature is a **thermometer**. There are two systems for measuring, both of which use **degrees** as the unit of measure.

   The first scale is measured in **degrees Fahrenheit**. The range from freezing point to boiling point on this scale is 32 to 212 degrees.

   The other scale is measured in **degrees Celsius**. Sometimes it is also referred to as the **Centigrade** scale. The range from freezing point to boiling point on this scale is 0 to 100 degree**s**.

4. **Time** can be defined in two ways. One is a measure of the period between two events, or the period in which something happens. The second definition is the precise moment determined by a **clock**.

   Time can be measured in several units. Refer to the timetable to see the different ways time can be expressed.

   One last thing to keep in mind about time is that we refer to the time of day as **a.m. (ante meridiem)** or **p.m. (post meridiem).**

   - **a.m.** refers to the hours after midnight and before noon.

   - **p.m.** refers to the hours after noon and before midnight.

Table of Time Conversions

1,000 milliseconds	1 second
60 seconds	1 minute
60 minutes	1 hour
24 hours	1 day
7 days	1 week
4 weeks	1 month
12 months	1 year
365 days	1 year
10 years	1 decade
10 decades	1 century
100 years	1 century
1,000 years	1 millennium

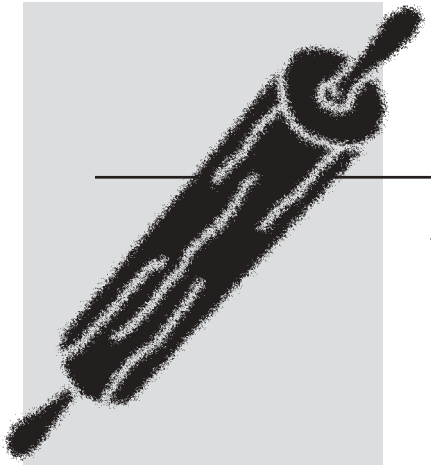
5. **Volume** is the amount of space taken up by a three-dimensional object. Volume often refers to **liquid volume**, which is defined as the amount of space taken up by a liquid, which spreads completely to fill its container.

Definitions adapted from The World of Measurement Web site: **oncampus.richmond.edu/academics/education/projects/webunits/measurement**

Math and Science Gumbo

Appendix

www.pbs4549.org/gumbo



Glossary

Area: The size that a surface takes up, measured in square units.

Bacteria: Any of a large group of one-celled round, spiral or rod-shaped microscopic organisms of various shapes that are often agents of fermentation and putrefaction and that may cause disease.

Chemical change: A change in matter that produces a new substance.

Circumference: The distance around a circle.

Estimation: Judging the approximate value, size or worth of something.

Fractions: When an object is divided into a number of equal parts, then each part is called a fraction.

Front-end rounding or truncating: To truncate means to shorten or cut off. A number that is truncated has all the numbers changed to zero after the number being rounded. For example, if you are truncating to the tens place, 57 = 50 and 422 = 420.

Fungi: Any organism, including mushrooms, yeasts, molds, rusts and others, characterized by lack of chlorophyll and by subsistence on organic matter.

Global Positioning System (GPS): A satellite-based navigation system made up of a network of 24 satellites orbiting the earth.

Length: A measure of how long something is from end to end.

Mass: The amount of matter in an object.

Matter: Something that occupies space (volume) and has weight (mass). There are three states of matter: solid, liquid and gas.

Microorganism or microbe: An organism that is so small that it is microscopic and invisible to the naked eye.

Money: A medium of exchange that comes in a variety of forms. The most common is currency – bills and change. Other forms of money include checks, credit cards, check cards, online banking, etc.

Perimeter: The distance around the outside of a shape.

Physical change: A change in matter where no new substance is produced.

Rounding: A number that has about the same value as the number you start with, but it is less exact.

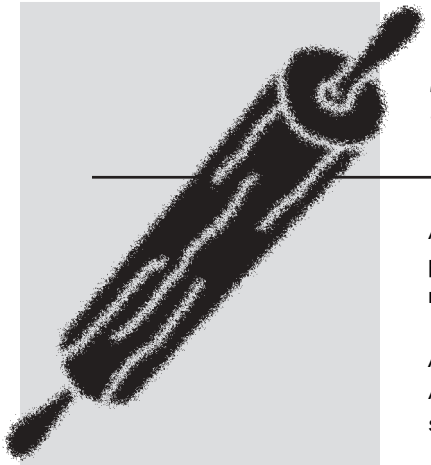
Temperature: The amount of warmness or coldness in an object.

Thermometer: An instrument used to measure temperatures or temperature changes.

Time: Defined in two ways. 1) A measure of the period between two events, or the period in which something happens. 2) The precise moment determined by a clock.

Truncating or front-end rounding: To truncate means to shorten or cut off. A number that is truncated has all the numbers changed to zero after the number being rounded. For example, if you are truncating to the tens place, 57 = 50 and 422 = 420.

Volume: The amount of space taken up by a three-dimensional object.



Food Bibliography

Anno, Mitsumasa. *Anno's Magic Seeds*. New York: Philomel Books, 1995. The reader is asked to perform a series of mathematical operations integrated into the story of a lazy man who plants magical seeds and reaps an increasingly abundant harvest.

Auch, Mary Jane, and Herm Auch. *The Princess and the Pizza*. New York: Holiday House, 2002. An out-of-work princess applies to become the bride of Prince Drupert, but first she must pass several tests, including a cooking contest.

Burns, Marilyn. *Spaghetti and Meatballs for All! A Mathematical Story*. New York: Scholastic Press, 1997. The seating for a family reunion gets complicated as people rearrange the tables and chairs to seat additional guests.

Cobb, Vicki, and Giulio Maestro. *More Science Experiments You Can Eat.* Philadelphia: Lippincott, 1979. Experiments with food demonstrate various scientific principles and produce edible results. Includes beef jerky, cottage cheese, synthetic cola and pudding.

D'Amico, Joan, Karen Eich Drummond, and Tina Cash-Walsh. *The Science Chef Travels Around the World*. New York: John Wiley, 1996. Introduces 14 countries, including Canada, Mexico and Brazil, and describes an experiment related to some basic food ingredient typical for each country. Also provides a recipe for a complete meal based on each food.

Demi. *One Grain of Rice: A Mathematical Folktale*. New York: Scholastic Press, 1997. A reward of one grain of rice doubles day by day into millions of grains of rice when a selfish raja is outwitted by a clever village girl.

Dobson, Christina, and Matthew Holmes. *Pizza Counting*. Watertown, MA: Charlesbridge, 2003. Decorated pizzas are used to introduce counting and fractions. Includes facts about pizza.

Gardner, Robert, and Jeff Brown. *Kitchen Chemistry: Science Experiments to Do at Home*. New York: J. Messner, 1982. Instructions for chemical experiments that can be done using the stove, refrigerator, counter, sink and materials commonly found in the kitchen.

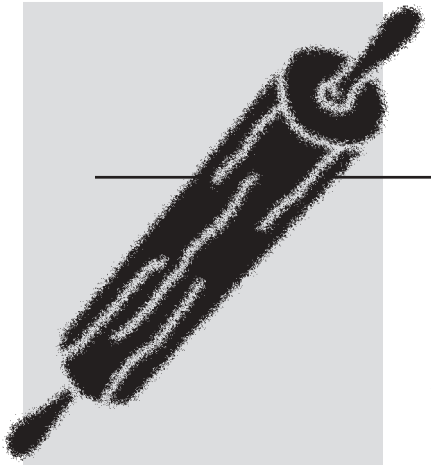
Gifford, Scott, and Shmuel Thaler. *Piece = Part = Portion*. Berkeley: Tricycle Press, 2003. Explains how in the language of mathematics, fractions, decimals and percents are three different ways of describing the same parts of things.

Kenda, Margaret, and Phyllis S. Williams. *Cooking Wizardry for Kids*. New York: Barron's, 1990. Instructions for nearly 200 creative kitchen projects, including a copper plating experiment, invisible ink, experiments with liquids and recipes for astronaut cookies.

Solheim, James, and Eric Brace. *It's Disgusting – And We Ate It! True Food Facts From Around the World – and Throughout History*. New York: Simon & Shuster Books, 1997. A collection of poems, facts, statistics and stories about unusual foods and both contemporary and historical eating habits.

Tang, Greg, and Harry Briggs. *The Grapes of Math: Mind Stretching Math Riddles*. New York: Scholastic, 2001. Illustrated riddles introduce strategies for solving a variety of math problems using visual clues.

Zubrowski, Bernie, and Signe Hanson. *Messing Around With Baking Chemistry*. Boston: Little Brown, 1981. Presents experiments and projects to explore what happens when batter and dough turn into cake and bread. Emphasizes the properties of baking powder, baking soda and yeast.



Non-Food Bibliography

Froman, Robert, and Byron Barton. *Angles Are as Easy as Pie*. New York: Crowell, 1975. Discusses facts about angles and their relationship to triangles, quadrangles, polygons and circles.

Markle, Sandra, and Cecile Schoberle. *Icky Squishy Science*. New York: Hyperion Paperbacks for Children, 1996. Details numerous science experiments that can be done at home; explains the various scientific phenomena involved and suggests further experiments.

Neuschwander, Cindy, and Wayne Geehan. *Sir Cumference and the First Round Table: A Math Adventure*. Watertown, Mass.: Charlesbridge, 1997. Assisted by his knight, Sir Cumference, and using ideas offered by his wife and son, King Arthur finds the perfect shape for his table.

---. *Sir Cumference and the Dragon of Pi: A Math Adventure*. Watertown, Mass.: Charlesbridge, 1999. When Sir Cumference drinks a potion that turns him into a dragon, his son Radius searches for the magic number known as pi that will restore him to his former shape.

---. *Sir Cumference and the Great Knight of Angleland: A Math Adventure*. Watertown, Mass.: Charlesbridge, 2001.

---. *Sir Cumference and the Sword in the Cone.* Watertown, Mass.: Charlesbridge, 2003. Sir Cumference, Radius and Sir Vertex search for Edgecalibur, the sword that King Arthur has hidden in a geometric solid.

Schwartz, David M, and Steven Kellogg. *If You Made a Million*. New York: Lothrop, Lee & Shepard Books, 1989. Describes various forms of money, including coins, paper money and personal checks, and how it can be used to make purchases, pay off loans or build interest in the bank.

Notes

PBS 45 & 45
1750 Campus Center Drive
Kent, Oh 44240-5191
330-677-4549
www.pbs4549.org