Grades 5–8

GOOD YEAR BOOKS

Aligns to National Council of Teachers of Mathematics Standards

CAREER MATH

Teaching Real-world Math Skills and Concepts

Hope Martin

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Correlates to the Common Core Standards for Mathematics

GOOD YEAR BOOKS

GDY431 v2.01

Educational Standards

Career Math contains lessons and activities that reinforce and develop skills as defined by the Common Core State Standards for Mathematics as appropriate for students in grades 5 to 8. These include the Content and Process Standards as indicated on the table of correlations on page vi.

Note: The separate Student Workbook includes all student activities, background information, and more.

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Contents

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Alignment to the CCSS

Activities	*Number and Operation*	*Algebra*	*Geometry*	*Measurement*	*Data & Probability*	*Problem Solving*	*Reasoning & Proof*	*Communication*	*Connections*	*Representation*
Math and Meteorology										
Keeping Track of Highs and Lows	●				●	●		●	●	
Continental Hot Spots	●	●		●		●		●	●	●
Let's Climb a Mountain	●				●	●		●	●	
The Heat Index	●	●			●	●		●	●	
Winter's Temperatures and Wind Chill		●			●	●		●	●	
The Science of Lightning	●					●	●	●	●	●
Average Rainfall around the World	●				●	●		●	●	
The Geometry of Hurricanes	●		●	●		●	●	●	●	
Math and Medicine										
Understanding & Reading Growth Charts	●			●	●	●		●	●	●
Reading the Blood Pressure Charts	●	●			●	●		●	●	●
Prescribing Medication	●			●						
Diabetes and Diet	●			●		●	●	●	●	
Average Weight for Boys and Girls	●			●		●		●	●	●
Designing a Doctor's Office	●		●	●	●	●	●	●	●	●
Math and Food Preparation										
Baking Raisin Muffins	●			●	●	●		●	●	
Using the Baker's Percentage	●	●		●		●		●	●	●
Percentages in a Side of Beef	●					●		●	●	
Edible Portion and Serving Size	●			●		●		●	●	
How Much Food to Order?	●			●		●		●	●	
Pattie's Pizza Parlor	●	●	●	●		●	●	●	●	
Math at the Zoo										
Lion Cub Math	●	●			●	●		●	●	
Polar Bear Growth vs. Human Growth	●	●		●	●	●	●	●	●	●
The Leaping Gazelle	●			●	●	●		●	●	
The Logic in Animal Species		●				●	●	●	●	●
The Remarkable Leaping Frog	●			●	●	●		●	●	
Feeding Gorillas at the Zoo	●			●	●	●		●	●	
Animal Enclosures	●	●	●	●		●		●	●	
Math and Personal Fitness										
Finding Your Heart Rate	●			●	●	●		●	●	
Our Basal Metabolism Rate	●	●		●		●		●	●	
Estimated Energy Requirements	●	●		●	●	●	●	●	●	
Walking for Your Health	●	●	●	●		●		●	●	
How Many Calories in a Cookie?	●			●	●	●		●	●	
Reading Product Labels	●			●	●	●		●	●	
The USDA's New Pyramid	●			●	●	●	●	●	●	●

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Introduction

What is the underlying philosophy of *Career Math*?

Children enter school believing that mathematics is relevant and important. They do not believe mathematics is an isolated subject with rules and procedures to be memorized but see math as a useful and efficient way to quantify and understand their world (NRC, 2001). By using math applications, *Career Math* makes important connections between *school math* and *real math*.

This book is for students in grades 5 through 8. The lessons can be used in a variety of ways—as replacement lessons, as supplementary materials in a regular classroom setting, or as parents' home schooling lessons. Each activity in *Career Math* teaches children vital mathematics skills and concepts using real-world applications.

In its introduction, The Common Core State Standards for Mathematics asserts, "These Standards are not intended to be new names for old ways of doing business. They are a call to take the next step. It is time for states to work together to build on lessons learned from two decades of standards based reforms. It is time to recognize that standards are not just promises to our children, but promises we intend to keep." (CCSS, p. 5) The document defines two interconnected components— the Standards for Mathematical Practice and the Standard for Mathematical Content.

The Standards for Mathematical Practice describe ways in which students should approach mathematical problems as they move through their elementary, middle and high school years. There should be a connection between what students need to know and the way they go about the process of learning it. The Mathematical Practices answer the question, "What do good problem solvers do?"

The Standards for Mathematical Content has balanced this combination of procedure and understanding. Students who lack understanding may rely on rote procedures to and without a firm understanding of what they are doing and why they are doing it, students may be less likely to consider similar problems, represent problems logically, give good reason for their conclusions, and be apply the mathematics to real-world situations. They will be unable to use technology correctly, to step back for an overview to reevaluate their thinking, or move away from a known procedure to find a shortcut. In short, a lack of understanding effectively hinders a student's mathematical progress.

The four main objectives of *Career Math* are to:

- Make connections between "school math" and their applications—how are these skills needed in the "real world"?
- Share the expertise of professionals, the people who use math every day, to help teachers answer the question, "When am I ever going to use this?"
- Use the Common Core State Standards and Mathematical Practices as a guide to focus on the important skills and concepts taught as these grade levels, and
- Make ready-to-use, motivating math activities available to help them answer the often-heard question, "When are we ever going to use this?"

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What does this book contain?

There are five careers highlighted in *Career Math*: meteorology, medicine, food preparation, animal care/zoology, and personal fitness. Each chapter contains an introduction that briefly describes the career and some of the mathematics skills needed to work in the field.

Each of the activities is preceded by a Teacher's Page that identifies:

- **Math Skills:** The skills and concepts contained in the lesson
- **Materials Needed:** The student activity sheets and other materials that are needed for the lesson to run smoothly (***Note:*** Some activities ask you to make transparencies of the activity sheets or background information sheets so that you can go over information with the class as a whole.)
- **Background Information and Suggested Teaching Strategies:** Background information about the activity.
- **Communicating through Journaling:** To encourage students to communicate mathematically, at least one journal question is included. You can use these questions as part of the assessment process. You can also use traditional assessment, such as tests, quizzes, and the accuracy of work on the student activity sheets.
- **Possible Extension Activities:** Provides suggestions for extension activities to facilitate differentiation of instruction. The entire class can participate in these activities or you can use them with students who might benefit from continued investigations.
- **Activity Answers:** Answers to questions asked of students on the activity sheets

At the ends of some of the chapters there are collections of puzzles. These puzzles review vocabulary and encourage students to use problem-solving strategies. There is also a list of related books and Web sites that you can use to supplement the math activities, supply additional practice for students, or make connections between math and literature.

You can teach the activities in *Career Math* in any order—choose them for the skills and concepts that best meet the scope and sequence of your mathematics program.

Children hear that "math is everywhere," and *Career Math* can be used to show them that this is true—math is, in fact, everywhere!

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Math and Meteorology

A meteorologist is a scientist who uses scientific principles to explain, understand, observe, and forecast the Earth's atmospheric phenomena and weather. While we're used to seeing meteorologists on TV forecasting and predicting the weather, not all meteorologists specialize in this field. Some meteorologists specialize in air pollution, changes in the global climate, and/or numerical analysis and forecasting.

The mathematics of meteorology is varied and sometimes quite complicated. Meteorologists collect data and use this data to make weather predictions; apply formulas to calculate heat indexes, dew point, and wind chill factors; and record weather phenomena, including record temperatures, rainfalls, and so on.

The mathematics of meteorology is algebra, data collection, organization and analysis, graphing, computation and percentages, and a great deal of problem solving.

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Keeping Track of Highs and Lows

Math Skills

- Collecting data
- Assigning units to graph coordinates
- Graphing

Materials Needed

- Weather reports for a ten-day period
- Colored pencils
- "Data Collection Sheet" (p. 5) for each student
- "Data Graphing Sheet" (p. 6) for each student

Background Information and Suggested Teaching Strategies

This lesson takes place over a ten-day period of time, but students can enter their data on the data table and on the graph daily. Because some students have difficulty with assignments that span an extended period of time, daily recordings narrow the duration of the activity.

On the line graph, a different-colored pencil should be used to record the high and low temperature for each day. Students can connect the coordinates because the temperature fluctuates between highs and lows. Students will also design a bar graph to compare the highs and lows.

You can ask students to analyze the graphs using the following types of questions:

1. Was the difference between the high and low temperature consistent?
2. What was the average difference between the high and low temperatures during this ten-day period?
3. Do you think the data we obtained now would be the same at other times of the year (at different seasons)?
4. Did all of the highs occur during the same time of day? Did all of the lows appear during the same time of day? Why do you think this occurred?

Communicating through Journaling

You designed two different graphs to represent the data you collected. Which graph do you think better pictured the data? Explain your answer.

Possible Extension Ideas

Students can enter the data into a computer spreadsheet and use the computer to design different types of graphs (such as bar graphs) Students can experiment with a variety of different graphs. Ask them which of these graphs are appropriate and which are not.

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Name _____ *Date* _____

Data Collection Sheet

Directions: Use the table below to record the high and low temperatures for your city for ten days. Then design a line graph to show the range of daily temperatures in your area.

Date																				
Temp																				
	H	L	H	L	H	L	H	L	H	L	H	L	H	L	H	L	H	L	H	L

Title _____

Temperature in °F

Date

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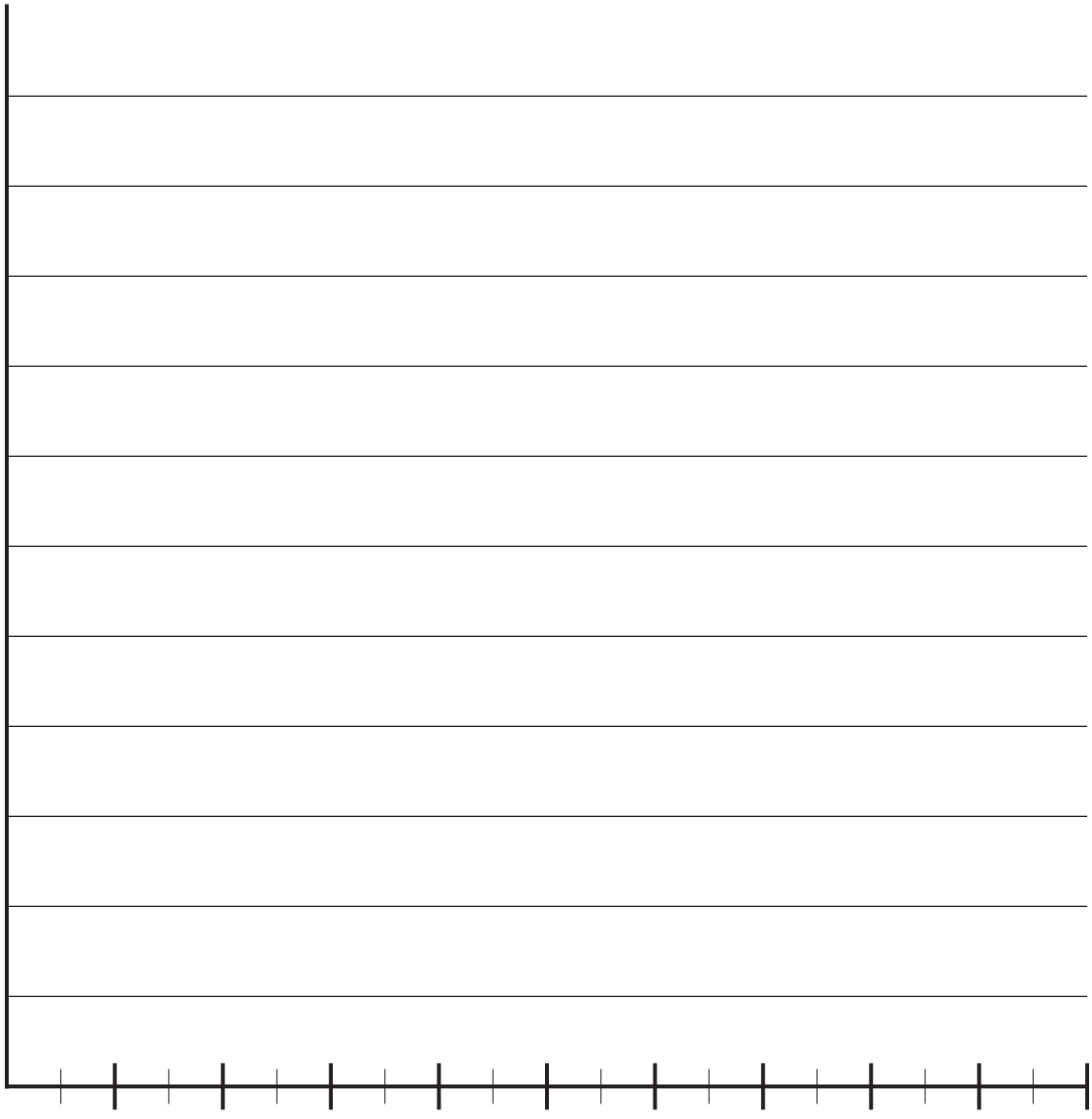
Name _____ *Date* _____

Data Graphing Sheet

Directions: Use the temperature data from the "Data Collection Sheet" to design a double bar graph of the high and low temperatures. Be sure to label the two axes of your graph.

Title _____



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Continental Hot Spots

Math Skills

- Substituting for a variable (algebra)
- Converting temperature
- Using computation skills

Materials Needed

- "Continental Hot Spots" (p. 8) activity sheet for each student
- Calculators

Background Information and Suggested Teaching Strategies

This activity asks students to convert temperatures from degrees Celsius to degrees Fahrenheit. This can be done by substituting the Celsius temperatures into a given equation, but it is a good idea to give students some benchmarks to help them better understand the approximate associations between the two scales. These are some familiar benchmarks:

1. Normal body temperature: 98.6°F ≈ 37°C
2. Room temperature: 68°F ≈ 20°C
3. Freezing point of water: 32°F ≈ 0°C
4. Boiling point of water: 212°F ≈ 100°C
5. A hot summer day: 90°F ≈ 32°C
6. A very cold winter day: 10°F ≈ –12°C

In other words, every 1° on the Celsius scale is approximately 2.12° on the Fahrenheit scale or every 1° on the Fahrenheit scale is approximately 0.47° on the Celsius scale. The conversion formulas are:

Fahrenheit to Celsius: $C° = \frac{5}{9}(°F - 32°)$

Celsius to Fahrenheit: $F° = (\frac{9}{5} \times °C) + 32°$

The table in "Continental Hot Spots" records the highest temperatures recorded on each of the continents and at the South Pole. Students are asked to convert the temperatures given in degrees Celsius to degrees Fahrenheit. There are a number of Web sites that contain conversion calculators. One of these is http://www.onlineconversion.com/temperature.htm. This site also converts to degrees Rankine, Reaumur, and Kelvin.

Communicating through Journaling

You are in a country where temperature is recorded in degrees Celsius. The local news tells you that the high for the day will be 24°. Without actually doing a conversion, how could you estimate this temperature in degrees Fahrenheit? About how many °F is 24°C? Explain how you solved this problem.

Answer: Students can use a variety of strategies to solve this problem. 24°C ≈ 75°F

Possible Extension Ideas

Students can use the Internet to research other temperature scales. The conversion calculator shown above can be used to convert temperatures in these scales to Fahrenheit.

Activity Answers

These answers have been rounded to the nearest degree:

Africa	136°F
North America	135°F
Asia	129°F
Australia	127°F
Europe	122°F
South America	120°F
Antartica	59°F
South Pole	7°F

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Name _____ *Date* _____

Continental Hot Spots

While temperature varies from place to place on the Earth, in most places the temperature is always between +50°C and –50°C. Just how hot or cold is this? In most of the world, temperature is measured using a scale developed in 1742 by a scientist named Anders Celsius. In the United States, we still use a scale developed in the early 1700s by a scientist named G. Daniel Fahrenheit. If you are given temperatures in degrees Celsius and you wish to convert it to degrees Fahrenheit, you can use this formula:

$$F° = \left(\frac{9}{5} \times °C\right) + 32°$$

Directions: The following table shows the highest temperatures recorded in each of the continents of the world and at the South Pole. Use the conversion formula to problem-solve what these temperatures would be on the Fahrenheit scale. These temperatures have been rounded to the nearest degree.

Continent	*Place*	*Year*	*Degrees Celsius*	*Degrees Fahrenheit*
Africa	El Azizia, Libya	1922	58	
North America	Death Valley, CA	1913	57	
Asia	Tirat Tsvi, Israel	1942	54	
Australia	Cloncurry, Queensland	1889	53	
Europe	Seville, Spain	1881	50	
South America	Rivadavia, Argentina	1905	49	
Antarctica	Vanda Station	1974	15	
South Pole	Unpopulated	1978	–14	

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Let's Climb a Mountain

Math Skills

- Using ratio and proportion to solve problems
- Scale drawing
- Computing percentages
- Analyzing using statistics

Materials Needed

- "The Temperature at the Top" activity sheet (p. 11) for each student
- "Drawings to Scale" activity sheet (p. 12) for each student
- Calculators
- A world map (extension activity)

Background Information and Suggested Teaching Strategies

Begin the lesson by discussing the information given at the beginning of the activity sheet. After reading it with students, ask: "What do you think is meant by the fact that 'temperature drops 3.5°F for every 1,000 ft' "? How do you know that it is colder on the top of a mountain than at its base? Why do you think this occurs? How do you think this might affect mountain climbers? How do you think you might solve this type of problem? What strategies could we use?" Give students an opportunity to discuss possible strategies because there are many ways to get to the correct answer. When students begin their calculations, remind them that there are questions that help to analyze their answers—remind them that these must be answered, as well.

A final activity asks students to draw a scale model of two mountains, Mt. Cook in Oceania and Mt. Everest in Nepal/Tibet. The graph paper is $\frac{1}{4}$ inch. Students need to problem-solve a scale that will allow both mountains to be drawn on this size paper.

Communicating through Journaling

Using metric measurements, temperature drops approximately 6.5°C for every 1,000 meters. Mt. Everest is 8,846 meters. How many degrees Celsius is the drop in temperature?

Answer: approx. 52.50°C.

Possible Extension Ideas

1. Using a world atlas or world map, ask students to locate each of the countries mentioned in the activity.
2. Students can use the Internet to research information about the tallest mountains. Some possible sites are:

   http://www.scaruffi.com/travel/tallest.html

   http://hypertextbook.com/facts/2001/BeataUnke.shtml

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Activity Answers

All measurements have been rounded to the nearest whole unit.

The Temperature at the Top (°F):

Mt. Everest	–34
Mt. Aconcagua	–12
Mt. McKinley	–3
Mt. Kilimanjaro	0.3
Mt. Elbrus	3
Vinson Massif	12
Puncak Jaya	12
Mont Blanc	13
Mt. Cook	25
Mt. Kosciusko	42

1. The range is 29,022 – 7,310 = 21,712 ft.

2. The median height is
(18, 506 + 16,050) ÷ 2 = 17,278 ft.

3. About four times the height

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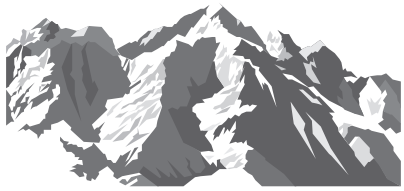
Name _____ *Date* _____

The Temperature at the Top



Did you know that the higher you go up a mountain, the colder it becomes? Because air cools as it rises, the temperature drops approximately:

3.5°F for every 1,000 ft

What if it were 68° F at the base of each of these mountains? What would the temperature be at the very top?

Directions: Use the ratio to help you solve these problems.

Name of Mountain	*Location*	*Height in Feet*	*Temperature at the Top (°F)*
Mt. Everest	Nepal/Tibet	29,022	
Mt. Aconcagua	South America	22,841	
Mt. McKinley (Denali)	Alaska, USA	20,320	
Mt. Kilimanjaro	Africa	19,336	
Mt. Elbrus	Russia	18,506	
Vinson Massif	Antarctica	16,050	
Puncak Jaya	New Guinea	16,023	
Mont Blanc	France/Italy	15,774	
Mt. Cook	New Zealand	12, 316	
Mt. Kosciusko	Australia	7,310	

Use the temperatures you calculated to help you answer these questions:

1. What is the range of heights of the mountains in this table? _____

2. What is the median height of these mountains? _____

3. How many times taller is Mt. Everest than Mt. Kosciusko? _____

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Name _____ *Date* _____

Drawings to Scale

Directions: Use the graph paper to draw Mt. Cook (12,316 ft) and Mt. McKinley/Denali (20,320 ft) to scale. The scale is $\frac{1}{4}$ inch = 750 ft. Each square is $\frac{1}{4}$ inch.

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The Heat Index

Math Skills

- Reading and interpreting a data table
- Solving problems

Materials Needed

- "Heat Index Chart" activity sheet (p. 14) for each student

Background Information and Suggested Teaching Strategies

Heat index is sometimes referred to as "apparent temperature" because it is a measure of how hot it feels when the relative humidity is added to the actual air temperature. Because the body cools itself by perspiring, the greater the relative humidity, the more difficult it is to perspire. This is because the air cannot hold as much moisture.

The Web site http://www.crh.noaa.gov/dvn/tools/heatindex.pdf contains an expanded Heat Index Chart. The following table, obtained from the same Web site, describes what possible heat disorders people in high-risk groups might face when the heat index is high:

Amount of Danger	*Heat Index*	*Effect on the Body*
Extreme Danger	≥ 130° F	Heat stroke or sunstroke is likely
Danger	105–129° F	Sunstroke, heat exhaustion
Extreme Caution	90–105° F	Sunstroke, muscle cramps
Caution	80–90° F	Possible fatigue

Source: Data from http://www.crh.noaa.gov/dvn/tools/heatindex.pdf

There is an equation used to calculate the approximate heat index. The equation was obtained using multiple regression analysis, and so the steps to obtain it are much too difficult to include here.

$$\text{Heat Index} = 42.379 + 2.04901523T + 10.14333127R - 0.22475541TR - 6.83783 \times \frac{1}{1000} T^2 - 5.48171 \times \frac{1}{100} R^2 + 1.22874 \times \frac{1}{1000} T^2R + 8.5282 \times \frac{1}{10{,}000} TR^2 - 1.99 \times \frac{1}{1{,}000{,}000} T^2R^2$$

In this formula T = Temperature in °F
R = Relative humidity

Communicating through Journaling

Explain what people mean when they say, "I know it's hot in Arizona in the summer but 100° doesn't feel as hot when I'm there." You may use the Heat Index Chart to help you answer this question.

Answer: Answers will vary but since Arizona has very low humidity with 0 or 10% relative humidity, 100° will "feel like" 91° or 95°.

Possible Extension Ideas

Advanced students may attempt to use the above formula to determine the heat index using data from a current weather report.

Activity Answers

1. Yes, it is true that "dry heat" does not feel as hot on our bodies as when there is higher humidity. 105° with 0% humidity feels like 95°—not exactly cool but cooler.
2. At both 70% and 80% humidity, the temperature becomes intolerable when it is 105° or higher.
3. Give students the opportunity to share their problems with the class. These student-generated problems can be solved by the rest of the class giving them additional practice reading the table.

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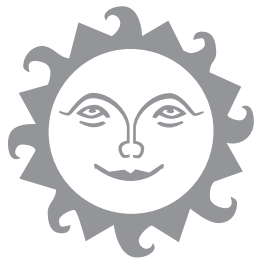
Name _____ *Date* _____

Heat Index Chart



The heat index is a combination of humidity and warm temperatures. It is how warm the air *seems to be* when the humidity is high.

Relative Humidity (%)

Temperature (°F)	0	10	20	30	40	50	60	70	80	90	100
110	99	105	112	123	137	150					
105	95	100	105	113	123	135	149				
100	91	95	99	104	110	120	132	144	157	170	
95	87	90	93	96	101	107	114	124	136	150	170
90	83	85	87	90	93	96	100	106	113	122	133
85	78	80	82	84	86	88	90.	93	97	102	108
80	73	75	77	78	79	81	82	85	86	88	91
75	36	70	72	73	74	75	76	77	78	79	80
70	64	65	66	67	68	69	70	70	71	71	72

Source: Data from http://www.crh.noaa.gov/dvn/tools/heatindex.pdf

Directions: Use the heat index chart to help you answer the following questions:

1. People say that when it's 105° in Las Vegas, Nevada, "it doesn't feel that hot because it's a dry heat." Does this seem to be true? What would the temperature feel like if there were 0% humidity? _____

_____

2. At what temperature would the heat feel intolerable if there were 80% humidity? What about 70% humidity? _____

_____

3. Use the chart to make up a problem to share with your class. Be sure to use the data on the Heat Index Chart. _____

_____

_____

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Winter's Temperatures and Wind Chill

Math Skills

- Reading data from a table
- Graphing, analyzing data

Materials Needed

- "Wind Chill Chart" (p. 17) for each student
- "Wind Chill Graph" activity sheet (p. 18) for each student
- "Informing the Public" activity sheet (p. 19) for each student
- Internet access

Background Information and Suggested Teaching Strategies

When we feel cold, it is because of the rate of loss of heat when our bodies are exposed to wind and cold. As the wind becomes stronger, our bodies lose heat at a faster rate, which causes our skin temperature to drop. Wind chill charts show the combination of wind speed and temperature has on body temperature. The formula used to calculate wind chill appears on page 17 with the Wind Chill Chart.

Additional information about wind chill appears on NOAA's National Weather Service Web site at http://www.nws.noaa.gov/om/windchill/. At that site you can download a booklet titled "Wind Chill Temperature Index" as a .pdf file. Also available is a calculator that computes wind chill from temperature and wind speed.

To begin the lesson, ask students, "Have you ever heard a meteorologist refer to the temperature outside in terms of wind chill?" (If you are in a warm climate and are not affected by wind chill, the Weather Channel is a good source of information.) Explain how the National Weather Service (NWS) notifies us when wind chill conditions reach critical thresholds. A "Wind Chill Warning" is issued when wind chill temperatures are life-threatening. A "Wind Chill Advisory" is issued when the conditions might become threatening. Examine the Wind Chill Chart with students and discuss the different shadings and what they mean. Choose a certain wind speed and ask about various temperatures. Have pairs of students make up problems and share them with the class.

When all of the students understand the table, give each student a copy of the blank graph and ask them to make a line graph of the effects of the wind on temperature when the temperature is 0°F. The final project is the newspaper article. Students can use reference materials or Internet sites to gather information for the article.

Communicating through Journaling

Go to the Web site http://www.nws.noaa.gov/om/windchill/. After downloading and reading the information in the booklet, explain in your own words what wind chill is and why we feel colder when there is a stronger wind.

Possible Extension Ideas

Give students an additional graph and assign the task of choosing their own temperature and designing a line graph to reflect the wind chill at that temperature.

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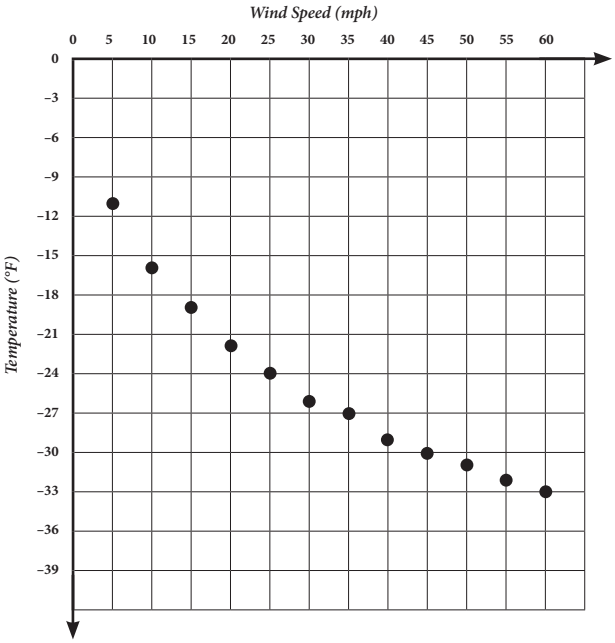
Activity Answers

Wind Chill Graph



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Wind Chill Chart

When we think about how cold it is outside, we have to consider the "How cold does it feel?" factor! The wind chill index describes an equivalent temperature at which the heat loss from exposed flesh would be the same if the wind was calm. However, the greater the speed of the wind, the colder it will feel, and the more damage there will be to exposed flesh.

The formula used to calculate wind chill is:

$$\text{WIND CHILL (°F)} = 35.74 + 0.6215T - 35.75(V^{0.16}) + 0.4275T(V^{0.16})$$

where V = wind speed (mph) and T = temperature (°F)

Wind Speed (mph)

Temperature (°F)	Calm	5	10	15	20	25	30	35	40	45	50	55	60
	40	36	34	32	30	29	28	28	27	26	26	25	25
	35	31	27	25	24	23	22	21	20	19	19	18	17
	30	25	21	19	17	16	15	14	13	12	12	11	10
	25	19	15	13	11	9	8	7	6	5	4	4	3
	20	13	9	6	4	3	1	0	–1	–2	–3	–3	–4
	15	7	3	0	–2	–4	–5	–7	–8	–9	–10	–11	–11
	10	1	–4	–7	–9	–11	–12	–14	–15	–16	–17	–18	–19
	5	–5	–10	–13	–15	–17	–19	–21	–22	–23	–24	–25	–26
	0	–11	–16	–19	–22	–24	–26	–27	–29	–30	–31	–32	–33
	–5	–16	–22	–26	–29	–31	–33	–34	–36	–37	–38	–39	–40
	–10	–22	–28	–32	–35	–37	–39	–41	–43	–44	–45	–46	–48
	–15	–28	–35	–39	–42	–44	–46	–48	–50	–51	–52	–54	–55
	–20	–34	–41	–45	–48	–51	–53	–55	–57	–58	–60	–61	–62
	–25	–40	–47	–51	–55	–58	–60	–62	–64	–65	–67	–68	–69
	–30	–46	–53	–58	–61	–64	–67	–69	–71	–72	–74	–75	–76
	–35	–52	–59	–64	–68	–71	–71	–76	–78	–79	–81	–82	–84
	–40	–57	–66	–71	–74	–78	–78	–82	–84	–86	–88	–89	–91
	–45	–63	–72	–77	–81	–84	–87	–89	–91	–93	–95	–97	–98

Source: From http://www.nws.noaa.gov/om/windchill/images/windchillchart3.pdf.

Key: Frostbite occurs after 30 minutes 10 minutes 5 minutes

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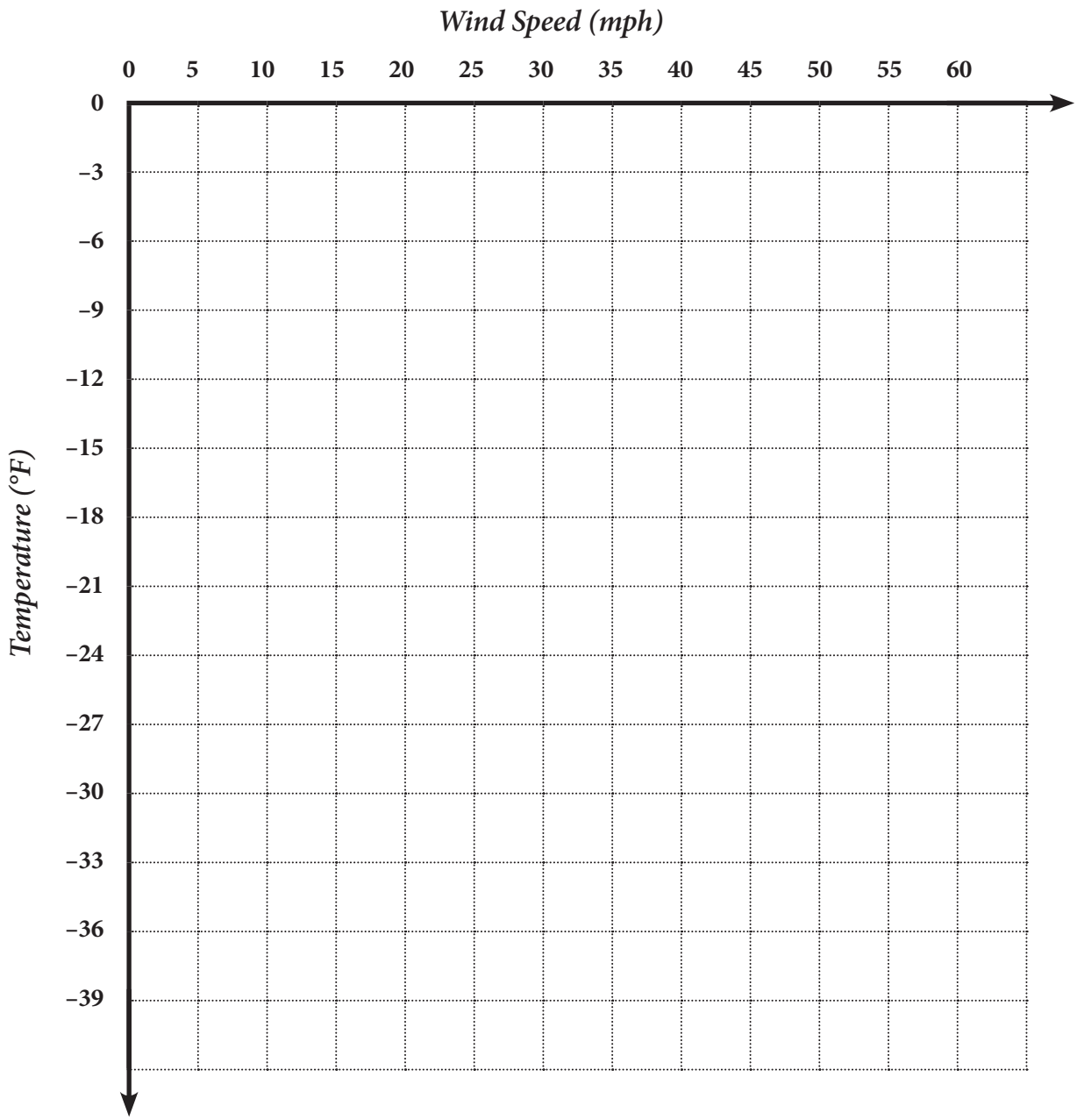
Name _____ *Date* _____

Wind Chill Graph

Directions: Use the graph below to draw a line graph of the wind chill at 0° F. Use the Wind Chill Chart for your data.

Title of Graph_____



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Name _____ *Date* _____

Informing the Public

Directions: It has been a very cold winter! You are the meteorologist assigned to the Daily News and your editor has asked you to write an article (1) explaining what wind chill is, (2) describing how wind chill affects the way we "feel" the cold, and (3) listing some examples from the Wind Chill Chart to help explain this phenomenon. Use the space below to write your article.

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The Science of Lightning

Math Skills

- Using ratio and proportion
- Using computation to solve measurement problems

Materials Needed

- "Lightning Strikes: Time and Distance" activity sheet (p. 21) for each student
- "An Original Story Problem" activity sheet (p. 22) for each student
- "How Much Is 8 Million?" activity sheet (p. 23) for each student

Background Information and Suggested Teaching Strategies

The flash we see from a lightning strike and the sound produced (thunder) occur at just about the same time. The reason we hear the thunder after we see the lightning is because of the speed at which light (lightning) travels and the speed of sound (thunder). Light travels at 186,000 miles per second. Sound travels at a speed of $\frac{1}{5}$ of a mile in the same time. By counting the number of seconds between the flash and the thunder and dividing by 5, we can estimate how far away the lightning strike occurred.

Lightning causes thunder because lightning is so hot that it superheats the air to between 15,000 and 60,000°F The super-hot air expands and then contracts very quickly (in the blink of an eye). Sound waves are formed and we call them thunder!

This lesson includes two activities. First, students will read some interesting lightning facts on "Lightning Strikes: Time and Distance." They will then use this information to write an original story problem. Second, after learning that there are 8 million lightning strikes around the world each day, students will work in pairs to complete an activity sheet that will help them understand how big a number 8 million really is.

Communicating through Journaling

Mathematicians have said, "There is a greater chance of being hit by lightning than winning the lottery." Research the odds of winning the lottery (either in your own state or in one that has a lottery) and analyze this statement, mathematically.

Answer: Answers will vary but the odds of being hit by lightning are approximately 576,000 to 1; the odds of being killed by lightning are approximately 2,320,000 to 1. The odds of winning the lottery depend on the state a person lives in and the type of game being played, but the odds of winning in California are approximately 13,000,000 to 1.

Possible Extension Ideas

Students can research the science of lightning and thunder. A few interesting sites are:

http://weathereye.kgan.com/cadet/lightning/thunder.html

http://www.windows.ucar.edu/cgi-bin/tour_def/earth/Atmosphere/tstorm/tstorm_lightning.html

http://www.nssl.noaa.gov/primer/lightning/ltg_basics.html

Activity Answers

Lightning Strikes: Time and Distance

$\frac{2}{5}$ mile

How Much Is 8 Million?

1. There are ≈ 93 lightning strikes per second.
2. Answers will vary.
3. It would be a little over 13 weeks before 8,000,000 seconds slip away.

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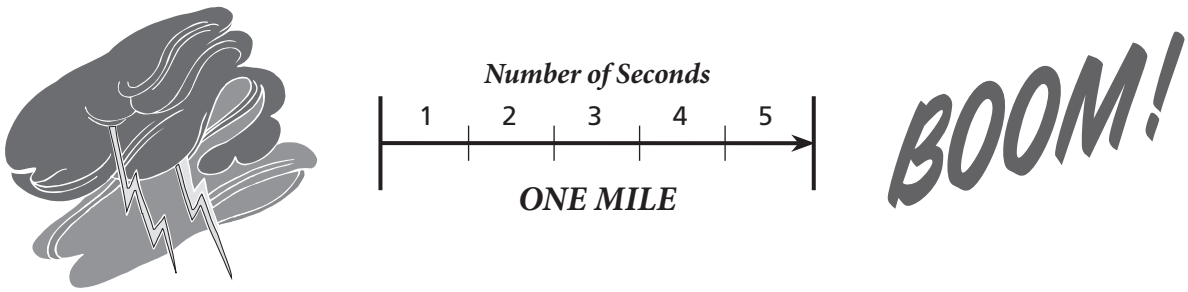
Name _____ *Date* _____

Lightning Strikes: Time and Distance

During every minute of every day, roughly 1,800 thunderstorms cause lightning strikes somewhere on Earth. Though the chances of being struck by lightning are estimated at 1 in 600,000, these huge electrical sparks are one of the leading causes of weather-related deaths in the United States each year. Did you know that we can calculate how far away the lightning is?

Here are some interesting facts about lightning:

- ☞ Thunder and lightning actually occur at the same time!
- ☞ Since light travels faster than sound, the light reaches you at once. Sound takes some time to reach you. Usually you see the lightning stroke before you hear the thunder.
- ☞ As soon as you see lightning, count the seconds until you hear the thunder. If there are 5 seconds, the lightning was about a mile away. (Sound travels about 1,000 feet a second.) This diagram helps explain this phenomenon:



- ☞ In metric terms, if it takes three seconds to hear the thunder, the storm is about a kilometer away.
- ☞ If you see lightning and hear thunder at just about the same moment, watch out. The storm is right above you, only a few hundred feet away.

Suppose you see a bolt of lightning and count 2 seconds between your sighting and when you hear the clap of thunder. How close would you approximate the lightning was from your location? _____

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Name _____ *Date* _____

An Original Story Problem

Directions: Work with a partner to make up a word problem related to the mathematics of lightning and thunder. Be prepared to share it with the class.

This is our solution. We have shown all of our steps.

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Name _____ *Date* _____

How Much Is 8 Million?

Did you know . . .

There are more than 8,000,000 lightning strikes each day?

1. How many lightning strikes would there be per second? _____

2. How many have there been since you were born? _____

Our Work:

3. How long will it take before 8,000,000 seconds pass by? Before you start to compute the answer, write your estimate here: _____

Our Work:

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Average Rainfall around the World

Math Skills

- Graphing (box-and-whisker plots)
- Analyzing statistics, solving problems

Materials Needed

- "Data Sheet" (p. 26) for each student
- "Graphing Average Rainfall" activity sheet (p. 27) for each student
- Rulers
- Calculators

Background Information and Suggested Teaching Strategies

Students are asked to use the data to design a box-and-whisker plot. This is a graph that uses medians—the size of each region on the graph is determined by the range of data in that region and not the amount of data. Each of the quartiles (or regions) contains 25% of the data! Steps to drawing a box-and-whisker plot:

1. Order the data from least to greatest (see box below).
2. Find the median—the median is between 37 and 39. The median is 38.
3. The Lower Quartile (LQ) is between 0 and 38—the median of the LQ is 16.
4. The Upper Quartile (UQ) is between 38 and 75—the median of the UQ is 53.
5. The range of the data is between 0.1 and 75.
6. On a box-and-whisker plot, the units on the graph must be at equal intervals. The line given allows the units to be 2—from 0 to 76.

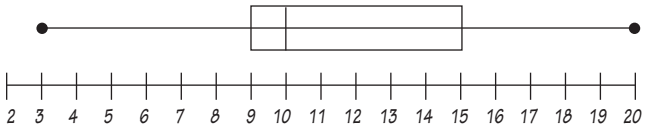
Communicating through Journaling

The following table shows the amount of hours some animals sleep. Draw a box-and-whisker plot to graph the data.

Animal	*Hours of Sleep*
Baboon	9
Horse	3
Cow	4
Rabbit	9
Dog	11
Pigeon	9
Cat	13
Squirrel	15
Bat	20
Armadillo	20

Source: Data from http://www.education-world.com/At_Home/student/student014.shtml. Used with permission.

Answer:



Possible Extension Ideas

Using data from the Web site http://www.weatherbase.com, you can research a city they wish to visit based upon the weather. Explain why you are going to that city (geographical and historical information), describe the weather, and decide what month would be the best time for you to go.

0.1 3 11 14 16 25 25 30 37 39 43 45 48 53 55 60 66 75

LQ M UQ

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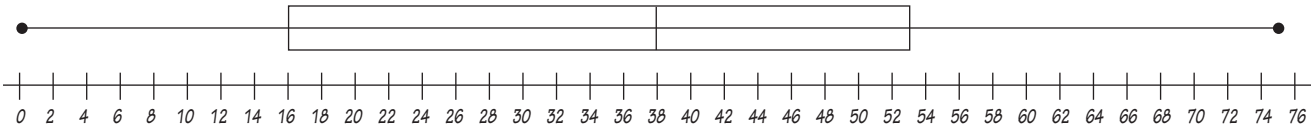
Activity Answers

1. The range of the data is 0.1 to 75—a range of 74.9.
2. 50% of the data is inside the box; 25% in the lower quartile and 25% in the upper quartile.
3. Students may express their answers differently, but the regions are not all the same size. They have the same number of pieces of data within each (as is shown above where the data is ordered from least to greatest) but their sizes vary because of the range of the data within each quartile—the greater the range, the larger the section.

   If students use units of 2, the graph will look like this:



4. The arithmetic mean is approximately 35.8 (rounded to the nearest tenth). Students may answer this in a different way but the mean is not the best statistic to use to analyze the data because the range of the data is so great.
5. There is a mode; it is 25. Again there are different ways to express the idea that this is not a valid statistic to use to analyze the data because the range is so great and comes from regions of the globe with much different lines of latitude.

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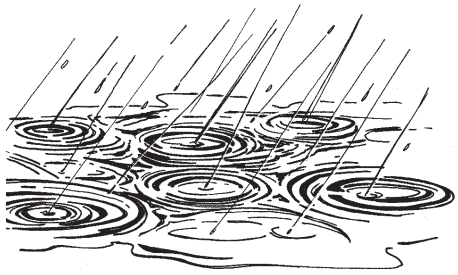
Data Sheet



Place	*Rainfall*
Annaba, Algeria	25
Tokyo, Japan	60
Buenos Aires, Argentina	39
South Pole, Antarctica	0.1
Durham, North Carolina	48
Toronto, Canada	30
Santa Maria, Cape Verde	3
Canton, China	66
San Juan, Puerto Rico	53

Place	*Rainfall*
Fairbanks, Alaska	11
Cartagena, Columbia	37
Cozumel, Mexico	75
Dakar, Botswana	16
Rio de Janeiro, Brazil	43
Istanbul, Turkey	25
Los Angeles, California	14
Quebec City, Quebec	45
Hamilton, Bermuda	55

(Totals in inches—Rounded to the nearest inch)

Source: Data from www.weatherbase.com.

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Name _____ *Date* _____

Graphing Average Rainfall

Directions: Use the data shown to draw a box-and-whisker plot and then use the graph to help you analyze the data and answer the questions.

- ☞ Order your data from least to greatest. _____

_____

- ☞ Determine the units you will use on the graph. _____
- ☞ Label the whiskers.
- ☞ Find the median, the lower quartile, and the upper quartile.
- ☞ Draw the "box."

1. What is the range of the data? _____

2. What percent of the data is inside the "box"? _____ In the lower quartile? _____ In the upper quartile? _____

3. Are all of the regions the same size? _____ If one of the regions is larger than the others, does that indicate that there is more data in that quartile? _____ Why or why not?_____

4. Find the arithmetic mean of this set of data. _____ Is this a valid statistic to analyze this set of data? _____ Why or why not? _____

_____

5. Is there a mode for this set of data? _____ If so, what is it? _____ Is this a valid statistic to measure the data? _____Why or why not? _____

_____

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The Geometry of Hurricanes

Math Skills

- Using geometry, area, and measurement skills
- Scale drawing
- Using ratio and proportion
- Graphing coordinates
- Using computation to solve problems

Materials Needed

- "Finding the Area of a Hurricane" student activity sheet (p. 30) for each pair of students
- "Tracking a Hurricane" student activity sheet (p. 31) for each pair of students
- Overhead transparencies of activity sheets
- Rulers
- Calculators

Background Information and Suggested Teaching Strategies

This investigation contains two different activities. The first shows a map of the Caribbean with two circles. The smaller of the two circles represents the eye of a hurricane and students are told that it has a diameter of 50 miles. The larger circle represents the hurricane but students are not given its diameter. The scale shown on the map indicates the following ratio: 1.5 in. : 500 mi. Metric measurements are also shown. Students are asked to measure its diameter (in inches) and, using the scale, calculate its diameter in miles. After finding the radius, students use the formula $A = \pi r^2$ to calculate the area of the entire hurricane (including the eye). The cross-hairs in the center of the eye are given to help students take an accurate measurement. It may help some students to review the terms *radius* and *diameter*. Also some students may need to be reminded of the formula for finding the area of a circle.

The second activity shows students a partial map of the Caribbean and the southeast coast of the United States. They are given the coordinates of the path of the hurricane and asked to plot the path using the symbol used by meteorologists.

Communicating through Journaling

If 1 mi^2 were uniformly covered by 1 in. of water, there would be approximately 17,370,000 gallons of water. The average bathtub holds about 50 gallons of water. How many bathtubs could be filled with the water covering 1 mi^2 covered by 1 in. of water?

Answer: 347,400 bathtubs

Possible Extension Ideas

There are many interesting Web sites where students can "see" a hurricane grow and learn more about the science of hurricanes. Two of these are:

http://scifiles.larc.nasa.gov/kids/Problem_Board/problems/weather/hurricanebasics.swf

http://www.ussartf.org/hurricanes.htm

Ask students to do a search to find other interesting sites to share. Additional activities might have students research the science of hurricanes for interdisciplinary lessons.

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Activity Answers

Finding the Area of a Hurricane

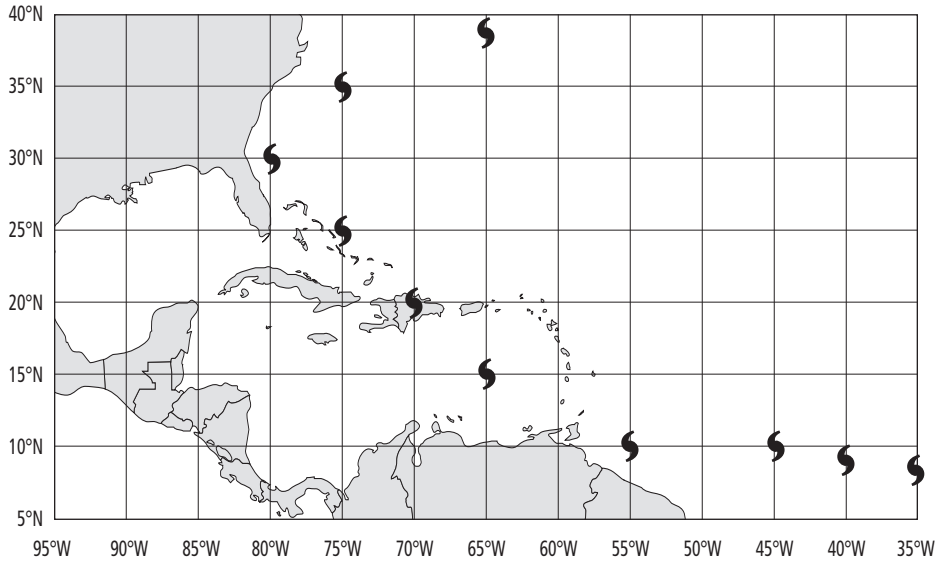
1. diameter = 500 mi (805 km)

2. radius = 250 mi (403 km)

3. $A = 3.14 \times 250^2$ $A = 196{,}250 \text{ mi}^2$

$A = 3.14 \times 403^2$ $A \approx 509{,}964 \text{ km}^2$

Tracking a Hurricane



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Name _____ *Date* _____

Finding the Area of a Hurricane

The two circles drawn on the map represent an imaginary hurricane. The center circle is called the *eye* of the hurricane. Typically, the eye has a diameter of between 20 and 40 miles (32 and 64 kilometers), but our hurricane has an eye that is 50 miles (80.5 kilometers) across. The outer circle represents the diameter of this hurricane. These vary in size.

Directions: Measure the diameter (in inches) of the hurricane and use the scale shown to calculate the actual diameter of this imaginary hurricane (including the eye).

1. The diameter of this hurricane is: _____ mi (_____ km)

2. Its radius is: _____ mi (_____ km)

3. Using 3.14 for π, find the area in mi^2 and km^2. Show your work here:

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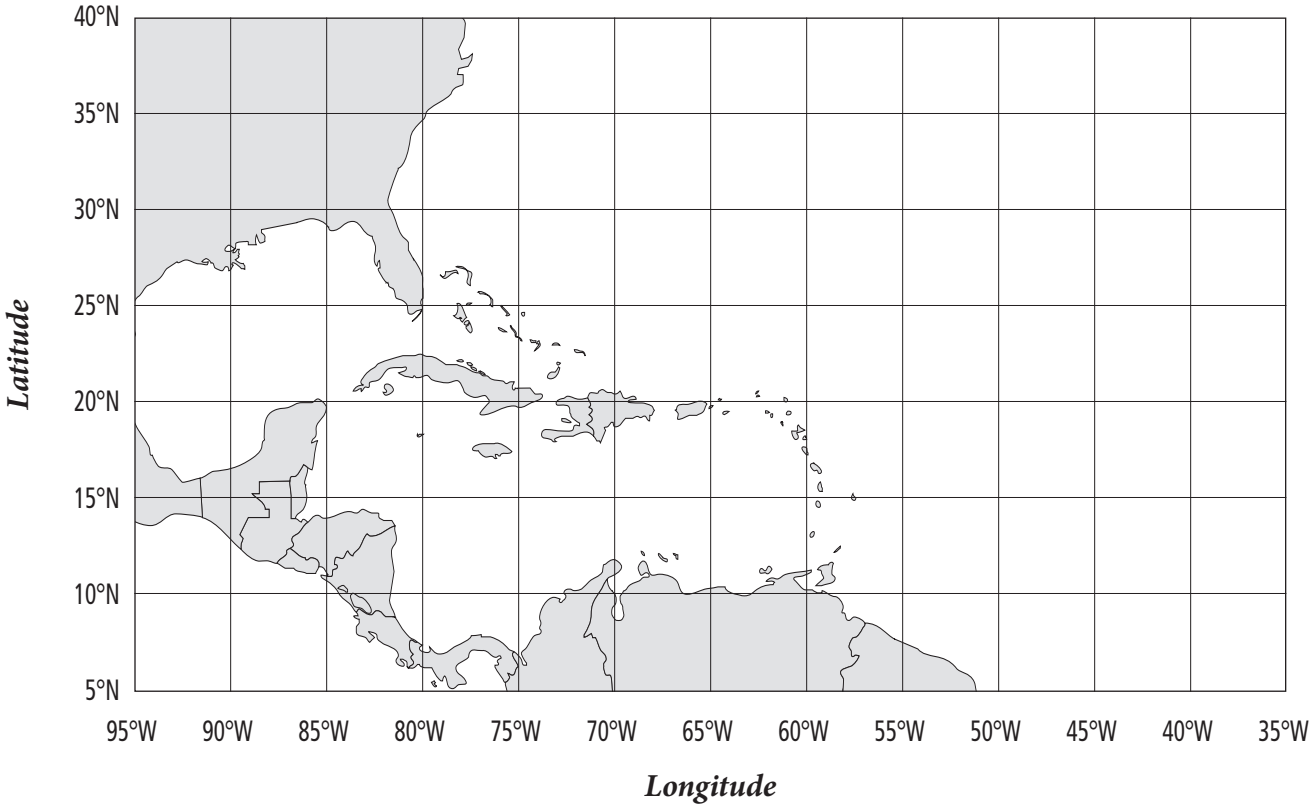
Name _____ *Date* _____

Tracking a Hurricane

This is the symbol used to represent a hurricane ❦. When meteorologists draw a map of the path of a hurricane, they place this symbol on the coordinate representing the degrees of longitude (East or West) and the degrees latitude (North or South).



Directions: Track our imaginary hurricane using the hurricane symbol and these coordinates:

1. 8°N, 35°W

2. 9°N, 40°W

3. 10°N, 45°W

4. 10°N, 55°W

5. 15°N, 65°W

6. 20°N, 70°W

7. 25°N, 75°W

8. 30°N, 80°W

9. 35°N, 75°W

10. 38°N, 65°W

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Name _____ *Date* _____

Unscramble the Weather

Directions: Unscramble each of these weather words. Then place the letters in the numbered boxes in the appropriate spot at the bottom of the page to receive a secret message.

R T W E A H E

D N W I L L I H C

E T H A N X I D E

M T T E R E U E P R A

F L A A N I R L

U H D Y M I I T

N N G L I T G H I

R I A S P R S E E R U

O W S N

R A R E B E M O T

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27

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Name _____ *Date* _____

A Weather Riddle

What kind of weather is it when it rains ducks?

To solve this riddle, answer each of these questions. Find the correct answer below and place the letter of the problem above its answer. When you complete the problems, you will learn the type of weather.

W At 1:30 P.M. the radio announces that a storm that is 105 kilometers away is approaching your town at a speed of 30 kilometers per hour. You want to be home before the storm arrives. At what time should you get home?

R On Sunday, the sun rose at 6:42 A.M. During the week, the sun will rise two minutes earlier each day. At what time will the sun rise on the following Saturday?

T The low temperatures for one week in your city were 62°F, 50°F, 68°F, 59°F, 50°F, 46°F, and 55°F. What was the range of the temperatures?

F Using the same data, what was the average low temperature for the week? Round your answer to the nearest whole degree.

E On Friday, the temperature was –13°F. On Saturday there was a *heat wave* and the temperature rose 30°F. What was the temperature on Saturday?

H One winter in the mountains it snowed a total of 32 ft (≈9.75 m) in December, January, and February. The first week of March it snowed an additional 5 ft (≈1.5 m). What percent of the previous total snowfall is the March addition? Round your answer to the nearest percent.

A Last week there were 2 cloudy days, 3 sunny days, and 2 rainy days. What percent of the days did it rain? Round your answer to the nearest percent.

L The formula we use to convert Celsius degrees to Fahrenheit degrees is: °F = ($\frac{9}{5}$ × °C) + 32°. The temperature in Mexico City is 35°C. What is the temperature in °F?

O The formula we use to convert Fahrenheit degrees to Celsius degrees is °C = $\frac{5}{9}$ (°F – 32). The temperature in Iceland is 41°F. What is the temperature in °C?

56°F	**5°**	**5:00**	**95°**		**5:00**	**17°F**	**29%**	**22°F**	**16%**	**17°F**	**6:32**

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Puzzle Answers

Unscramble the Weather

WEATHER
WIND CHILL
HEAT INDEX
TEMPERATURE
RAINFALL
HUMIDITY
LIGHTNING
AIR PRESSURE
SNOW
BAROMETER
APRIL SHOWERS BRING MAY FLOWERS

A Weather Riddle

W At about 5:00 P.M.
R 6:32
T 22°F
F 56°F
E 17°F
H 16%
A 29%
L 95°
O 5°

FOWL WEATHER

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Math and Meteorology:

Books and Web Sites

Books

- Adams, S. *The Best Book of Weather*. New York: Kingfisher, 2001.
  A good introduction to the world of weather. Wind, snow, thunderstorms and rain are covered as well as more dramatic events such as hurricanes and tornadoes.

- Allaby, M. *How the Weather Works*. New York: Reader's Digest, 1999.
  A collection of hundreds of experiments that let students discover the way the weather works. There is also a "Cloud Atlas" that explains the way clouds are classified and identifies all of the main types.

- Kahl, J. D. W. *National Audubon Society First Field Guide: Weather*. New York: Scholastic Research, 1998.
  This book explains what weather is, how it is measured, and how to build observation devices at home. There is a thorough guide to cloud types, storms, and precipitation. There's also a well-organized reference section. An excellent resource for information on waterspouts, golfball-sized hail, and other fascinating weather facts.

- Wills, S., and Wills, S. R. *Meteorology: Predicting the Weather*. New York: Oliver Press, 2003.
  This book profiles seven major figures in the history of meteorology, from Luke Howard, who developed our classification system for cloud types, to such household names as Ben Franklin and Daniel Gabriel ("sometimes called Gabriel Daniel") Fahrenheit.

- Young, H., and Oxlade, C. *Discovery Plus: Weather and Sky*. San Diego, CA: Silver Dolphin, 2000.
  See the devastation that giant storms, hurricanes, typhoons, and cyclones cause around the world. Land on the moon, discover Saturn's rings and Halley's Comet, plus many other fun and adventurous experiences. Features a variety of interesting facts, color photographs, and detailed illustration.

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Math and Meteorology:

Books and Web Sites

Web Sites

The following sites are part of The National Oceanic and Atmospheric Administration web site. The NOAA is part of the U.S. Department of Commerce and is an invaluable resource for both mathematics and science teachers. When new information becomes available the NOAA may change the URLs for some of the sites but search the site for this information…it will be there!

- www.srh.noaa.gov/jetstream/append/downloads.htm
  Posters that are available on this site include these posters: Hurricane Katrina, Hurricane Rita, "Bolt from the Blue" (a poster about lightning), "Night of 1000 Trains" (about tornadoes), "Owlie Skywarms Weather Book" (facts about hurricanes, tornadoes, lightning, floods, winter storms, and weather quizzes, a cloud chart, a wind chill chart, a heat index chart, a hurricane tracking chart. Most of these posters are 27x40. Some of these are available in smaller sizes and all are available free of charge. There are also a large variety of information wheels including heat index, water cycle, hurricane damage potential, cloud spotter, and more.

- www.weather.gov
  Part of this site includes a weather and atmosphere link (www.weather.gov) has a large number of resource links that include El Nino I, Hurricanes, Space Weather, Weather Observations, and Weather Systems and Patterns.

- www.nws.noaa.gov/om/edures.shtml
  This site was designed for teacher use and includes links for classroom materials, student sites, graphics, photos and images, other weather sites, and additional links. The student site links include games, FEMA's kid links and more.

- cirrus.sprl.umich.edu/wxnet/servers.php
  A University of Michigan site that provides access to over 150 North American weather sites—some are commercial, others are regional or local sites and some are other university meteorology sites.

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Math and Meteorology:

Books and Web Sites

- www.100toplibrarysites.com/?cat=Weather
  Contains the 100 top weather sites—too many to name but worth taking a look at (especially if your interested in photos and articles from hurricane hunters or links to Arctic weather-related sites.

- www.nws.noaa.gov/om/water/XWATER/index.shtml
  This site lets you download QuickTime 3.0 to take a video tour showing the dangers of driving in low water. There is a quiz to check your awareness of flood dangers, too.

- www.oar.noaa.gov/k12/
  This Web page provides middle-school students with research and investigation experiences using online resources. Even if you do not have much experience in using Web-based science activities, the directions here are easy to follow. Weather topics include tornadoes, lightning, hurricanes, and forecasting.

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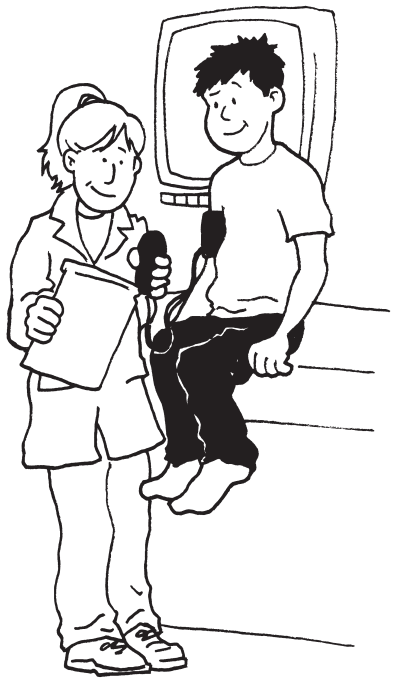
Math and Medicine

We all know that doctors need to have an extensive background in the sciences, but they know that mathematics plays an important role in their jobs. Our interview with a pediatrician demonstrated just how important math is. Some of the tasks a doctor must perform are to prescribe the correct dosage of medicine based upon the weight of the child, determine if the child's growth (height and weight) is following a normal pattern, and decide whether the child's blood pressure is normal. Doctors must be observant and excellent problem solvers.

Along with traditional computational skills, doctors must be extremely proficient in conversion from English to metric units, be able to read and interpret complex charts and graphs, and understand percentile ranks and their importance. Dr. Deborah Gulson was a great help in writing this chapter by explaining how mathematics plays such an important part of the work she does every day. Permission to use the tables and charts used in this section was obtained from the Centers for Disease Control.



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Understanding & Reading Growth Charts

Math Skills

- Reading charts and graphs
- Converting within and between systems
- Using computation to solve problems

Materials Needed

- "Understanding and Reading Growth Charts" activity sheets (pp. 41 and 42) for each pair of students
- Two CDC Growth Charts (one for boys and one for girls; pp. 43 and 44) for each pair of students
- Overhead transparencies of both CDC Growth Charts
- Calculators

Background Information and Suggested Teaching Strategies

Before students begin working in pairs to analyze the growth charts from the Centers for Disease Control, it is important that they examine the charts and understand what is meant by percentile ranks. The first page of the student lesson includes questions that you can use with the class as a whole to find out if students are able to read and understand the markings on the graph. Here are some additional questions to discuss with students before using the charts:

1. What units of measure are used on this chart to indicate the height of the children?
2. Are these heights on the *x* or the *y* axis?
3. On what axis are the ages of the children?
4. At the end of each of the graph lines, we see the numbers 3rd, 5th, 10th, 25th, and so on. These are called *percentiles*. What do you think they stand for?
5. Why do you think the lines are so close together at birth and become further apart by the time the child reaches 36 months?

Percentiles may be a new concept for students—they need to understand that if a child falls in the 3rd percentile that only 3% of the population is shorter than the child and 97% is taller.

After working on the first page with the class, allow students to work in pairs to answer problems 7–12. Students are asked to develop a question about the chart to share with the class. At the end of the lesson, give each pair of students the opportunity to share their question and ask the class to work out the solution.

Communicating through Journaling

When the doctor tells a parent that their child's height falls in the 50th percentile on the CDC's Growth Chart, what does that mean?

Answer: Answers may vary but the 50th percentile means that statistically 50% of children are shorter and 50% are taller.

Possible Extension Ideas

Students can find the height of each student in their grade level and analyze this data by finding the mean, median, mode, and range.

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Activity Answers

1. The heights in both centimeters and inches

2. The height in inches and the percentiles

3. Students may answer this differently but the lines are not straight because the growth patterns of children are not linear; sometimes children grow at faster rates and so the slope of the line is steeper.

4. Percentiles divide the population into groups based on how they relate to others in the same group. If someone is at the 95th percentile of height, only 5% of the population is taller and 95% is shorter.

5. a. 10th percentile

b. approximately the 20th percentile

c. about 91 cm

6. 78 cm

7. It is very close, but the boy's percentile rank would be lower.

8. Students may answer differently but the percentile rank appears to be about halfway between 25 and 50—the 37th or 38th percentile seems about right.

9. About 29.5 inches

10. Boys' height at the 97th percentile, age 36 months, is 41 in. or 104 cm; girls are at 40.5 in. or 103 cm.

11. Student answers may vary greatly, but it appears that both boys' and girls' growth rates are similar. At birth, the range of heights for boys varies from 18 to just under 22 in.; the birth height of girls varies from just under 18 to about $21\frac{1}{2}$ in. Students can use these two height ranges to formulate their answer.

12. Answers will vary.

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Name _____ *Date* _____

Understanding & Reading Growth Charts

Directions: Examine the two CDC Growth Charts titled "Length-for-age percentiles": one for boys and one for girls, to help you solve these problems.

1. What scales appear on the left side of the graph? What do they represent? _____

_____

2. What is on the right side of the graph? What do they represent? _____

_____

3. Why are these graphs not represented by straight lines? _____

_____

4. These graphs are expressed in percentiles: 3rd, 5th, 10th, 25th, 50th, 75th, 90th, 95th, and 97th percentiles. What do you think these percentiles mean? If someone falls in the 95th percentile on the stature graph, would he or she be tall or short for his or her age? Explain your answer. _____

_____

_____

5. A child's height at 36 months is recorded at 36 inches.

a. A boy of this height is at about what percentile? _____

b. A girl at this height is at about what percentile? _____

c. Thirty-six inches is about how many centimeters tall? Use the growth chart to help you answer this question. _____

6. About how tall would a 15-month-old girl be if she fell into the 50th percentile? Give your answer in centimeters. _____

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Name _____ *Date* _____

Understanding & Reading Growth Charts (continued)

7. Would a 15-month old boy who was the same height be in the same percentile rank?

_____

8. If not, in what percentile rank would the boy be? Explain how you found your answer.

_____

_____

9. Use the chart to help you convert the height of a 15-month-old boy who is about 75 cm tall. _____

10. At the 97th percentile, compare the heights of boys and girls at 36 months. Be sure to explain the heights using both metric and customary units of measure.

_____

_____

11. At what age do you think the heights of boys and girls are the most alike? Explain why you chose this age. _____

_____

12. Work with your partner to develop a question based on the data found on the growth charts. Solve your original problem and then be prepared to share it with the rest of the class. _____

_____

_____

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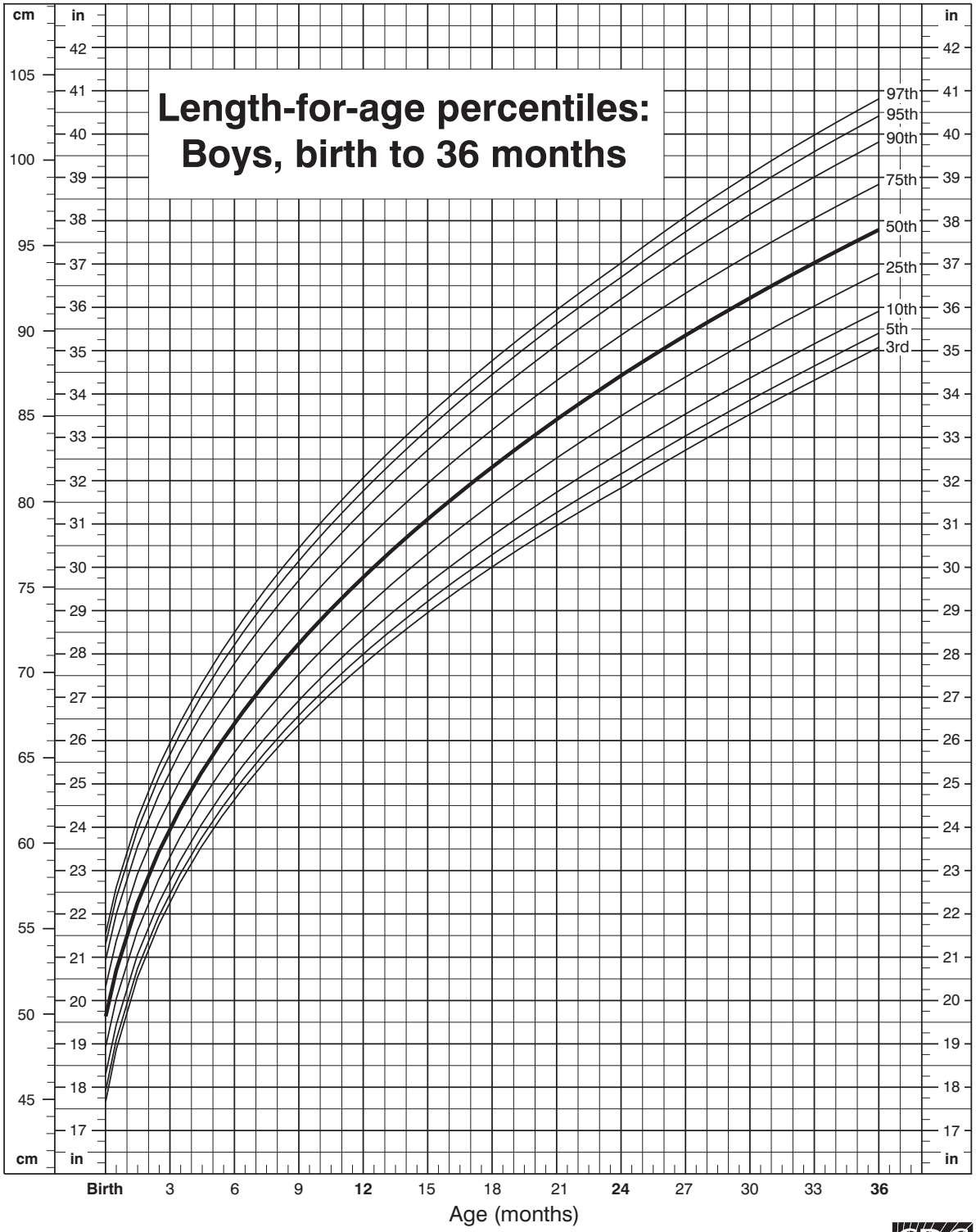
CDC Growth Charts: United States



Published May 30, 2000.
SOURCE: Developed by the National Center for Health Statistics in collaboration with the National Center for Chronic Disease Prevention and Health Promotion (2000).

CDC
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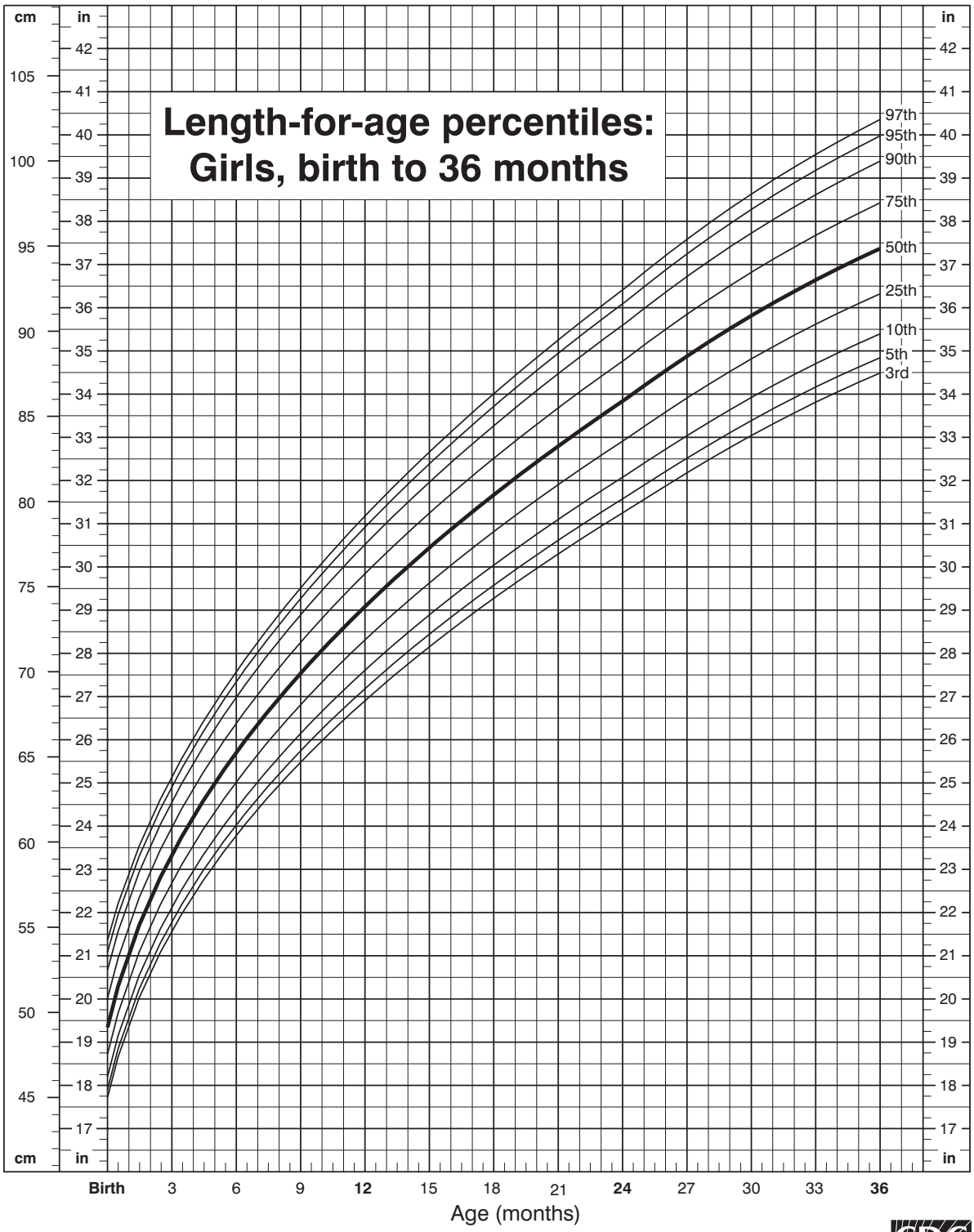
CDC Growth Charts: United States



Published May 30, 2000.

SOURCE: Developed by the National Center for Health Statistics in collaboration with the National Center for Chronic Disease Prevention and Health Promotion (2000).

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Reading the Blood Pressure Charts

Math Skills

- Reading charts and graphs
- Computing percentiles
- Computing percent of increase
- Solving problems

Materials Needed

- "Reading the Blood Pressure Charts" activity sheet (p. 47) for each student
- "Blood Pressure Charts" page (p. 48) for each student
- Overhead transparencies of enlarged charts

Background Information and Suggested Teaching Strategies

Blood travels from the heart through arteries to all parts of the body. Blood pressure is the force of the blood pushing against the walls of the arteries. Each time the heart beats (about 60 to 70 times a minute at rest), it pumps out blood into the arteries.

A blood pressure reading consists of two numbers, one for systolic blood pressure and one for diastolic pressure. The charts in this lesson show systolic blood pressure. It is the higher of the two pressures recorded because it is taken when the heart is beating and pumping blood. Between beats, the heart rests and the blood pressure falls. This is the diastolic pressure. While it is not shown on these charts, the diastolic pressure is the second number given when blood pressure is recorded. For example, suppose a person's blood pressure is 120/80 (or 120 over 80): 120 is the systolic BP and 80 is the diastolic BP. The table below shows the systolic and diastolic blood pressure for children at the 90th percentile based upon their height and weight. The *y* axes on the charts are labeled "systolic BP"—the background information supplied may be helpful in explaining the two types of blood pressure.

Blood Pressure Data for Girls —90th Percentile—Based Upon Height and Weight													
Systolic	105	106	107	108	108	111	112	114	115	117	119	121	124
Diastolic	69	68	68	69	69	70	71	73	74	75	76	77	79
Height (cm)	80	91	100	108	115	122	129	135	141	147	153	159	166
Weight (kg)	11	14	16	18	22	25	29	34	39	44	50	56	62

Blood Pressure Data for Boys —90th Percentile—Based Upon Height and Weight													
Systolic	105	105	106	107	109	111	112	114	115	117	119	122	124
Diastolic	67	69	69	69	69	70	71	72	74	75	77	78	80
Height (cm)	77	89	98	107	115	122	129	135	142	148	154	160	165
Weight (kg)	11	13	15	18	22	25	30	35	40	45	51	58	63

Source: From http://www.cdc.gov/nchs/about/major/nhanes/growthcharts/clinical_charts.htm.

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If you explain this blood pressure data to students, have them view the chart at http://www.cdc.gov/nchs/about/major/nhanes/growthcharts/clinical_charts.htm, which compares heights and weights for boys and girls ages 2 to 20. Using this chart, students can relate the ages of the children to the heights and weights described on the tables. Like the previous lesson, this activity separates the blood pressure data of girls and boys and records the data as percentiles. If students have worked on the growth chart activity, they should be familiar with the use of percentiles to explain the data. If they are not, students will need to understand what is meant by the 50th, the 75th, the 90th, or the 95th percentiles.

Page 48 shows an enlarged version of the two graphs so that you can make an overhead transparency. You can display the transparency to help students analyze the graph and the data.

Communicating through Journaling

When designing a graph, explain how you can manipulate the units on the *y* axis to make the graph misleading. Give an example of such a graph.

Answer: Answers may vary but by manipulating the *y* axis and eliminating 0, very small differences can appear much larger than they really are. Students may use graphs used in advertising or newspapers to show misleading graphs.

Possible Extension Ideas

Have students find graphs used in advertising and the newspapers and label them as misleading or informative. Ask them to separate these graphs and students can discuss what attributes in each of the categories (informative or misleading) led to their labeling. Have students correct those graphs that are considered to be misleading.

Activity Answers

1. Boys: $[(110 - 92) \div 92] \times 100 = 20\%$

Girls: $[(110 - 90) \div 90] \times 100 = 22\%$

Both of these answers have been rounded to the nearest percent. Answers may vary based on how students interpret graphs. Accept any reasonable answer.

2. It is also important for students to recognize that the units on the *y* axis begin at 90 and then continue up in intervals of 5. If it did not show compression of units, the blood pressure at age 13 for girls would appear to be about 15 times higher than at age one. In actuality, it is only about 20 points higher or about 1.2 times higher. Without showing compression, this graph would be very misleading.

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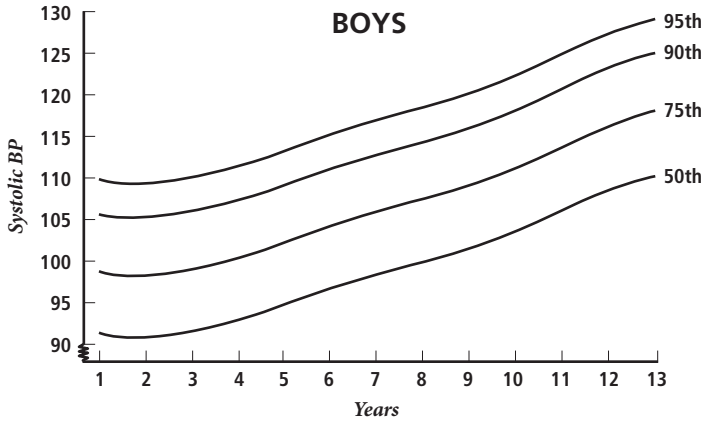
Name _____ *Date* _____

Reading the Blood Pressure Charts

Directions: Use information on the following charts to answer the questions that follow.



1. How much does blood pressure change between the ages of 1 and 13 for boys and girls at the 50th percentile? _____ What is the percent of increase for boys? _____ ; for girls? _____ To find the percent of increase you can use this formula:

$$\text{Percent of Increase} = \frac{\text{Amount of Increase}}{\text{Pressure at Age 1}} \times 100$$

2. If the graph did not indicate that it had been compressed (it starts at 90 rather than at 0), would the graphs be misleading? Explain your answer. _____

_____

_____

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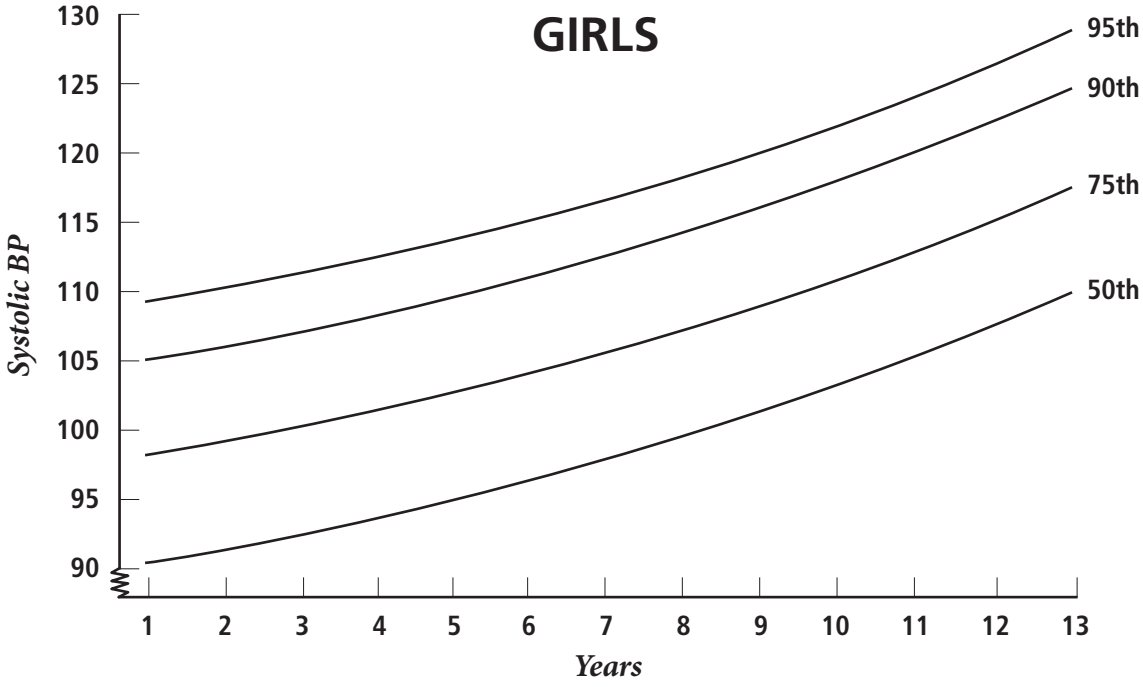
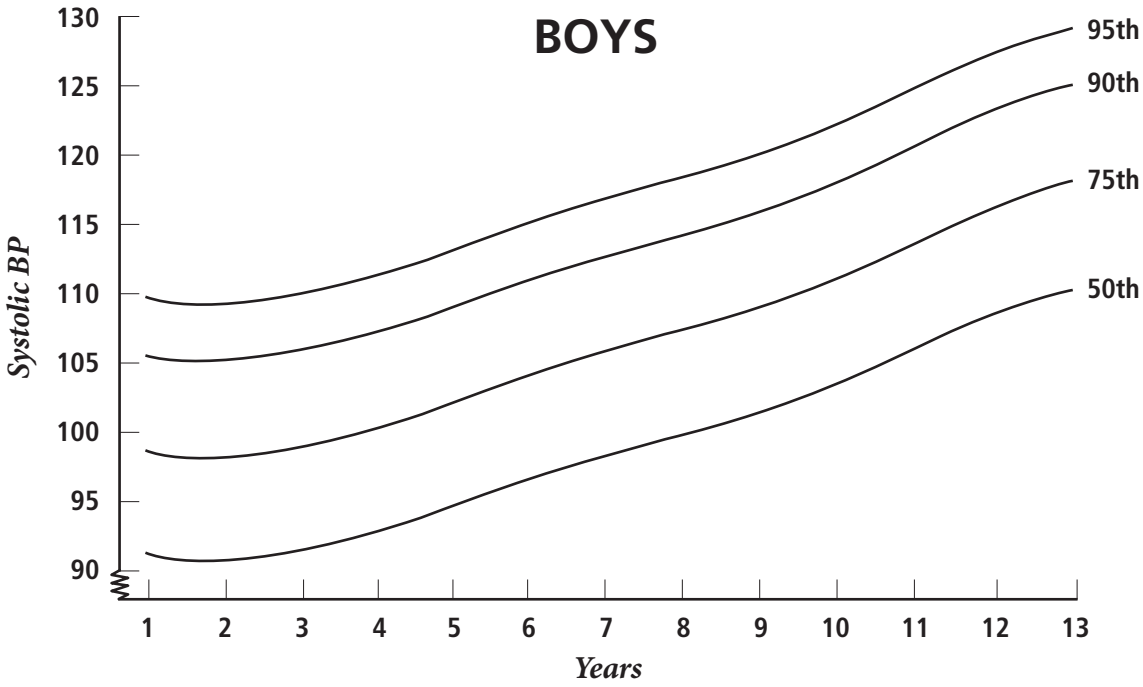
Blood Pressure Charts





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Prescribing Medication

Math Skills

- Using computation to solve problems
- Converting between the metric and customary system of measurement

Materials Needed

- "Prescribing Medication" activity sheet (p. 50) for each pair of students
- Calculators

Background Information and Suggested Teaching Strategies

While it is not recommended that students convert between the metric and customary systems, it is a skill that is required of many of today's professionals—from carpenters using tools calculated in metric units to doctors who need to know how to convert pounds to kilograms and milliliters to teaspoons. The problems in this activity refer to two doctors: One is treating a child with a bad cold and is required to calculate the correct dosage of medicine and the second is required to calculate an intravenous drip based upon body weight and dosage requirements.

Communicating through Journaling

A medication given to dogs to control the pain of arthritis has the following dosage requirements: 4.4 mg/kg of body weight once daily. Marcus has a German Shepherd that weighs 82 lbs. How many mg of medicine should Marcus's dog receive each day? (1 kg ≈ 2.2 lbs).

Answer: Students must first convert 82 lbs to 37.3 kg. 37.3 kg × 4.4 mg/kg ≈ 164 mg. Marcus' dog should receive 164 mg/day.

Possible Extension Ideas

Have students interview their pediatricians to gain information about how their doctors use conversion skills to prescribe medications to their patients. Ask students to share their findings with the class.

Activity Answers

1. a. 1 lb/0.45 kg = 38 lbs/x; x = 17.1 kg. 17.1 x 2.2 = 37.62 ml each day

b. 37.62÷ 5 = 7.524 teaspoons per day ÷ 4 ≈ 1.9 or 2 tsps each time. It appears that the dosage is correct (0.1 teaspoons is less than 0.1 oz).

2. Converting 93 lbs to kg: 93 x 0.45 = 41.85 kg. 4 cc/hr for the first 10 kg, 2 cc/hr for the next 10 kg, and 1 cc/hr for the remainder of her body weight is 7 cc/hr.

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Name _____ *Date* _____

Prescribing Medication

Directions: Doctors must be very careful when they prescribe medication. Most medicines are labeled in metric units so being able to convert and give parents and nurses the proper dosages and times is essential. Work with your partner to solve each of these problems.

1. Marisa goes to the doctor with a very bad cold. She weighs 38 pounds (lbs). The doctor prescribes a medicine to help reduce fever. The medicine comes with these directions: "This medication is to be administered using the following ratio: 2.2 milliliters (ml) per 1 kilogram (kg) of body weight." To solve this, you need to know that 1 lb ≈ 0.45 kg or 1 kg ≈ 2.2 lbs and 5 ml ≈ 1 teaspoon (tsp).

a. About how many milliliters of medicine should Marisa receive each day? Show your work here. _____

_____

_____

b. The doctor prescribed 2 tsps of the medicine 4 times each day. Do you think this was the right dosage? Why or why not? (Be specific and explain your answer.)

_____

_____

2. A pediatrician is taking care of a 12-year-old girl in the hospital. The patient weighs 93 lbs. She is to receive an intravenous drip that has the following directions:

☞ The fluid drip should be 4 cubic centimeters (cc) per hour for the first 10 kg of body weight.

☞ Add 2 cc per hour for the next 10 kg of weight and 1 cc per hour for body weight over 20 kg. To solve this, you need to know that 1 lb ≈ 0.45 kg or 1 kg ≈ 2.2 lbs.

How many cc per hour of medicine should this girl receive so that she gets the correct amount of medications based upon her weight of 93 lbs? _____

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Diabetes and Diet

Math Skills

- Reading tables
- Measuring using the metric system
- Using computation to solve problems

Materials Needed

- "Diabetes and Diet—Nutrition Labels" sheets (pp. 53 and 54) for each student
- "Counting the Carbs" activity sheet (pp. 55) for each student
- Calculators
- Internet access

Background Information and Suggested Teaching Strategies

Blood sugar or glucose is formed as our body digests food. The pancreas then releases the hormone insulin, which allows glucose to enter our body's cells. This glucose is then converted to energy. Diabetes is a disease in which the body either does not produce insulin or does not use it properly. If glucose builds up in the blood instead of going into cells, these cells become starved for energy, and over a period of time damage can be done to other organs and body systems.

While there is more than one type of diabetes, two types are the most common and account for about 95% of all of the diagnosed cases of diabetes. The one that primarily strikes children and young adults is called *type 1*, or juvenile-onset diabetes. In this type the body's immune system destroys the cells that make the insulin. In *type 2*, or adult-onset diabetes, the body does not properly use the insulin that is produced.

In both types of diabetes, it is essential to limit the amount of carbohydrates consumed. In general, for every 15 g of carbohydrates consumed, 1 unit of insulin is required to help the body's cells absorb the carbohydrates they need for energy.

This lesson shows the nutrition labels for a breakfast, lunch, and dinner that was eaten by a person with diabetes. It is not specified whether the person is a type 1 or type 2 diabetic, but because the activity is being used with students, perhaps it should be assumed that it is a child eating this imaginary meal.

Communicating through Journaling

Because diabetics need to limit their intake of carbohydrates, design a menu that includes breakfast, lunch, and dinner and reduces the number of items consumed that are high in carbohydrates. Information about healthy diabetic diets can be obtained on the following Web site: http://www.diabetes.org/nutrition-and-recipes/nutrition/healthyfoodchoices.jsp.

Possible Extension Ideas

Sometimes food labels can be misleading. Some labels list calories for servings that are much smaller than a person might normally consume. For example, the fruit punch juice drink on the lunch menu is only a 3.5 oz size—most drinks are at least 8 oz. For an 8-oz drink, the number of calories increases to 400 from the listed 175—*this is an increase of 399%*. Have students compute the number of calories consumed for the day using the serving sizes on the labels, and then have them compare that figure with what it would be using more realistic serving sizes.

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Activity Answers

Breakfast	
Carbohydrates in:	
Juice	10.06
Cereal	24.08
Milk	4.78
Total Amount of Carbohydrates	38.92
Amount of Insulin Needed	≈ 2.59

Lunch	
Carbohydrates in:	
Hamburger	18.02
Apple	15.25
Juice Drink	43.10
Total Amount of Carbohydrates	76.37
Amount of Insulin Needed	≈ 5.09

Dinner	
Carbohydrates in:	
Pizza	31.15
Milk	11.66
Brownie	35.78
Total Amount of Carbohydrates	78.59
Amount of Insulin Needed	≈ 5.24

1. The total number of carbohydrates consumed was 193.88. This amount requires 12.93 units of insulin. This child would most probably be required to administer three different dosages—one after breakfast, one after lunch, and one after dinner.
2. Student answers will vary but a good diet will include all of the food groups and spread the carbohydrates evenly throughout the day.

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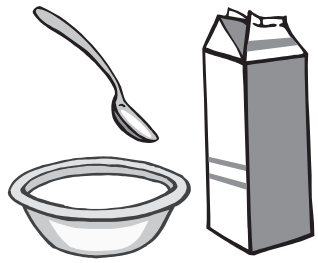
Diabetes and Diet—Nutrition Labels

Your pancreas produces insulin, which allows your body to absorb the carbohydrates you eat into your blood. A diabetic's pancreas cannot produce insulin naturally and so people with this disease need to take shots of a man-made insulin to process the carbohydrates. Although the amount may vary, generally for every 15 grams of carbohydrates taken into the body, a diabetic must inject 1 unit of insulin.



On this page and the next, you will find the nutrition labels of the foods eaten by a diabetic. On the page titled "Calculate the Carbs," use these labels to determine the amount of carbohydrates this person consumed.

Breakfast

Orange Juice		
Nutrition Facts		
Serving Size		
Standard Measure (100g/3.5oz)		
Amount per Serving		
Calories 44 kcal		
		% Daily Value
Total Fat	0.27 g	1%
Saturated Fat	0.029 g	1%
Polyunsaturated Fat	0.046 g	
Monounsaturated Fat	0.064 g	
Cholesterol	0 mg	0%
Sodium	1 mg	1%
Total Carbohydrates	10.06 g	4%
Dietary Fiber		0%
Sugars		
Protein	0.80 g	

Corn Flakes		
Nutrition Facts		
Serving Size		
1 cup (1NLEA serving) (28g/1.0oz)		
Amount per Serving		
Calories 101 kcal		
		% Daily Value
Total Fat	0.22 g	1%
Saturated Fat	0.056 g	1%
Polyunsaturated Fat	0.056 g	
Monounsaturated Fat	0.112 g	
Cholesterol	0 mg	0%
Sodium	203 mg	9%
Total Carbohydrates	24.08 g	9%
Dietary Fiber	1.0 g	4%
Sugars	1.96 g	
Protein	1.96 g	

2% Milk		
Nutrition Facts		
Serving Size		
Standard Measure (100g/3.5oz)		
Amount per Serving		
Calories 42 kcal		
		% Daily Value
Total Fat	1.06 g	2%
Saturated Fat	0.660 g	4%
Polyunsaturated Fat	0.306 g	
Monounsaturated Fat	0.039 g	
Cholesterol	4 mg	2%
Sodium	51 mg	3%
Total Carbohydrates	4.78 g	2%
Dietary Fiber	0.0 g	0%
Sugars		
Protein	3.29 g	

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Diabetes and Diet—Nutrition Labels (continued)

Lunch

Hamburger		
Nutrition Facts		
Serving Size		
Standard Measure (100g/3.5oz)		
Amount per Serving		
Calories 268 kcal		
		% Daily Value
Total Fat	15.10 g	24%
Saturated Fat	5.582 g	28%
Polyunsaturated Fat	6.571 g	
Monounsaturated Fat	1.286 g	
Cholesterol	48 mg	16%
Sodium	345 mg	15%
Total Carbohydrates	18.02 g	7%
Dietary Fiber		0%
Sugars		
Protein	14.80 g	

Fresh Apple		
Nutrition Facts		
Serving Size		
Standard Measure (100g/3.5oz)		
Amount per Serving		
Calories 59 kcal		
		% Daily Value
Total Fat	0.36 g	1%
Saturated Fat	0.058 g	1%
Polyunsaturated Fat	0.015 g	
Monounsaturated Fat	0.105 g	
Cholesterol	0 mg	0%
Sodium	0 mg	0%
Total Carbohydrates	15.25 g	6%
Dietary Fiber	2.7 g	11%
Sugars		
Protein	0.19 g	

Fruit Punch Juice Drink		
Nutrition Facts		
Serving Size		
Standard Measure (100g/3.5oz)		
Amount per Serving		
Calories 175 kcal		
		% Daily Value
Total Fat	0.70 g	2%
Saturated Fat	0.087 g	1%
Polyunsaturated Fat	0.086 g	
Monounsaturated Fat	0.173 g	
Cholesterol	0 mg	0%
Sodium	10 mg	1%
Total Carbohydrates	43.10 g	15%
Dietary Fiber	0.2 g	1%
Sugars		
Protein	0.30 g	

Dinner

Mushroom and Sausage Pizza		
Nutrition Facts		
Serving Size		
1 serving (132g/4.7oz)		
Amount per Serving		
Calories 306 kcal		
		% Daily Value
Total Fat	13.73 g	22%
Saturated Fat	5.069 g	26%
Polyunsaturated Fat	4.435 g	
Monounsaturated Fat	2.086 g	
Cholesterol	26 mg	9%
Sodium	718 mg	30%
Total Carbohydrates	31.15 g	11%
Dietary Fiber		0%
Sugars		
Protein	14.39 g	

Milk		
Nutrition Facts		
Serving Size		
1 cup (244g/8.7oz)		
Amount per Serving		
Calories 102 kcal		
		% Daily Value
Total Fat	2.59 g	4%
Saturated Fat	1.610 g	9%
Polyunsaturated Fat	0.747 g	
Monounsaturated Fat	0.095 g	
Cholesterol	10 mg	4%
Sodium	124 mg	6%
Total Carbohydrates	11.66 g	4%
Dietary Fiber	0.0 g	0%
Sugars		
Protein	8.03 g	

Brownie		
Nutrition Facts		
Serving Size		
1 square, large (2-3/4"sq x 7/8") (56g/2.0oz)		
Amount per Serving		
Calories 227 kcal		
		% Daily Value
Total Fat	9.13 g	15%
Saturated Fat	2.372 g	12%
Polyunsaturated Fat	5.020 g	
Monounsaturated Fat	1.265 g	
Cholesterol	10 mg	4%
Sodium	175 mg	8%
Total Carbohydrates	35.78 g	12%
Dietary Fiber	1.2	5%
Sugars		
Protein	2.69 g	

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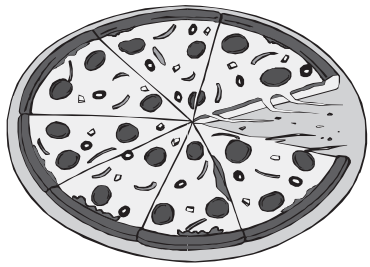
Name _____ *Date* _____

Calculating the Carbs



Directions: Using the information from the sheets titled "Diabetes and Diet—Nutrition Labels," record the number of grams of carbohydrates that this person consumed. Use the tables below. Then answer the questions that follow. Remember that 15 g of carbohydrates requires 1 unit of insulin.

Breakfast	
Carbohydrates in:	
Juice	
Cereal	
Milk	
Total Amount of Carbohydrates	
Amount of Insulin Needed	

Lunch	
Carbohydrates in:	
Hamburger	
Apple	
Juice Drink	
Total Amount of Carbohydrates	
Amount of Insulin Needed	

Dinner	
Carbohydrates in:	
Pizza	
Milk	
Brownie	
Total Amount of Carbohydrates	
Amount of Insulin Needed	

1. What is the total number of grams of carbohydrates this person ate? _____

How many units of insulin would this person need to administer? _____

2. Investigate the diet that is recommended as healthy for people with diabetes. The information on the Web site http://www.urbanext.uiuc.edu/diabetes2/tests/eval.cfm?tID=5 will help you plan healthy meals. Be sure to "Test Your Knowledge" after you have explored the site. My healthy diet for a person with diabetes (breakfast, lunch, dinner):

_____

_____

_____

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Average Weight for Girls and Boys

Math Skills

- Reading charts
- Graphing
- Solving problems with fractions
- Converting customary measurements

Materials Needed

- "Growth Chart" (p. 57) for each student
- "Blank Graph" activity sheet (p. 58) for each student

Background Information and Suggested Teaching Strategies

The data found on the table represents the average or mean weights for girls and boys. It shows a range of months or years rather than the data on previous graphs. The mean weight for girls ages 3 to 6 months is listed as $14\frac{1}{2}$ lbs.

Discuss with students the value of each of the fractions listed and equate them to a number of ounces. Ask students to convert $\frac{1}{4}$ lb to 4 oz, $\frac{1}{2}$ lb to 8 oz, and $\frac{3}{4}$ lb to 12 oz.

Other conversions are the fractional parts of a year found in the ages. Again ask students to convert $\frac{1}{2}$ year to 6 months and $\frac{3}{4}$ year to 9 months.

Give students the opportunity to choose a graph type to represent the data. Two possible choices are a line graph or a double bar graph. After students have completed their graphs, ask them to discuss the reasons they chose the graph they did.

Communicating through Journaling

Discuss why it is important for a doctor to be able to convert easily from the metric system to our customary system of measurement.

Answer: Answers will vary but students should understand that since all statistical data and medicine dosages are generally given in the metric system, the doctor must be able to make the conversions to the system of measurement best understood by the patient.

Possible Extension Ideas

Collect data about yourself and design a graph to reflect that data. For example, collect measurements of foot length and height and record them on a frequency table with that of other students. Data that has two variables lends itself to scatterplot graphs, where ordered pairs are used to represent each of the variables. The ordered pair (foot length, height), can be plotted on the coordinate plane with foot length graphed on the horizontal axis and height on the vertical axis. The result is an interesting graph. The data can also be entered into a spreadsheet program and a scatterplot drawn by technology!

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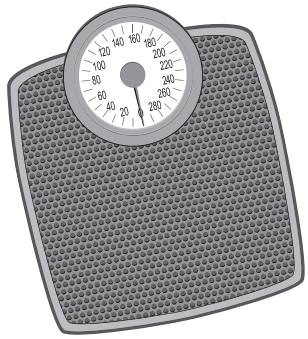
Growth Chart



This table shows the average weights for girls and boys between the ages of 3 months and 6 years. Your job is to design a graph that represents this data. Use the "Blank Graph" page to draw your graph.

Age	*Weight (in lbs)*
3–6 months	Girls: $14\frac{1}{2}$
	Boys: 16
6–9 months	Girls: $18\frac{1}{4}$
	Boys: $19\frac{3}{4}$
9–12 months	Girls: $20\frac{1}{2}$
	Boys: $22\frac{1}{2}$
1–$1\frac{3}{4}$ years	Girls: $23\frac{1}{2}$
	Boys: $24\frac{1}{4}$
1–2 years	Girls: $24\frac{3}{4}$
	Boys: 27
2 years	Girls: 29
	Boys: $30\frac{1}{2}$
3 years	Girls: $33\frac{1}{4}$
	Boys: $34\frac{3}{4}$
4 years	Girls: $38\frac{3}{4}$
	Boys: $39\frac{3}{4}$
5 years	Girls: $42\frac{1}{2}$
	Boys: $44\frac{1}{2}$
6 years	Girls: $47\frac{1}{2}$
	Boys: $48\frac{1}{2}$

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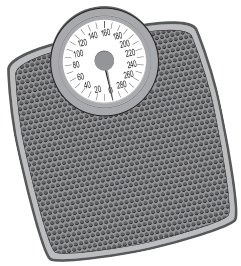
Name _____ *Date* _____

Blank Graph



Directions: There are different types of graphs that you can design that will represent the data in the table on "Growth Chart" page. Use the grid below to design the graph. Be sure to include a title and units for both axes.

Title _____

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Designing a Doctor's Office

Math Skills

- Calculating area
- Solving problems related to percentages

Materials Needed

- "Figuring Dimensions" activity sheet (p. 61) for each student
- "Drawing the Design" activity sheet (p. 62) for each student
- Overhead transparencies of student sheets
- Rulers
- Calculators (optional)

Background Information and Suggested Teaching Strategies

This activity has two parts—the first part describes a doctor's office by telling the students the number of rooms/areas and its percentage. They are also told that the entire office has 2,000 ft^2. The table on the "Figuring the Dimensions" activity sheet asks students to convert the percentages to square feet. While most students would think calculators are needed, there is a way to compute the square footage easily by using "Easy Percents." One percent of 2,000 = 20, so 9% = 9 x 20 or 180 ft^2. Once students understand that to find 1% they divide by 100 (or move the decimal point two places to the left), finding the percentages called for in this activity becomes child's play.

Communicating through Journaling

Suppose your bedroom is 10 ft by 12 ft (including the closet). You have a closet that is 2 ft deep and runs all the way along the 10-ft-long wall. What percent of the total square footage of your room does the closet take up? Explain how you solved this problem.

Answer: The total square footage of the room is 120 ft^2; the square footage of the closet is 20 ft^2. The ratio $\frac{20}{120}$ = 16.666% or approximately 17%.

Possible Extension Ideas

An interesting extension activity can be found at http://www.geology.wisc.edu/~museum/hughes/DinoDraw.html. This lesson was authored by Martin F. Goldsmith of Menomonee Falls High School in Menomonee Falls, Wisconsin. It describes how students can use scale and proportion to make a life-sized drawing of a dinosaur's head.

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Activity Answers

Figuring Dimensions

Room	*Percentage*	*Area (in ft²)*
Exam Room #1	9%	**180**
Exam Room #2	9%	**180**
Exam Room #3	12%	**240**
Doctor's Office	6%	**120**
Waiting Area	15%	**300**
Reception Room/Offices	20%	**400**
Bathroom	6%	**120**
Central Open Area	23%	**460**
TOTAL	100%	**2000**

Drawing the Design

The "Drawing the Design" activity has a 10-by-10 grid that represents 100% of the total office space. Students are asked to design an efficient office for the doctor using the percentages shown on the table on "Figuring Dimensions." While there is no correct answer, some designs will make more sense than others. For example, should access to the bathroom be through an exam room? Discuss with students that the Central Open Area should be accessible to all of the rooms that the doctor and medical staff will be using. Perhaps it is the area where there is a table the doctor can use to write out prescriptions or where there are scales that can be used to weigh patients before they go into the exam rooms. Most students have had experience visiting a doctor and should be able to join in on the brainstorming session that precedes the completion of the drawing.

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Name _____ *Date* _____

Figuring Dimensions

It is very important that a doctor's office be both efficient and patient-friendly. The doctor and her assistants need to have enough space to take care of both their patients and all of their records. The patients need a comfortable place to wait for the doctor and for their examination.

This doctor's office has eight rooms and/or areas for both patient and medical personnel use. There is a total of 2,000 square feet (ft^2) in the office.

Directions: The table below names each area and how large it is in relation to the whole office. This is shown as a percentage. Complete the table.

Room	*Percentage*	*Area (in ft^2)*
Exam Room #1	9%	
Exam Room #2	9%	
Exam Room #3	12%	
Doctor's Office	6%	
Waiting Area	15%	
Reception Room/Offices	20%	
Bathroom	6%	
Central Open Area	23%	
TOTAL	100%	**2,000**

Now, use the percentages on this page and the 100-square grid on the "Drawing the Design" page to design an efficient office for the doctor.

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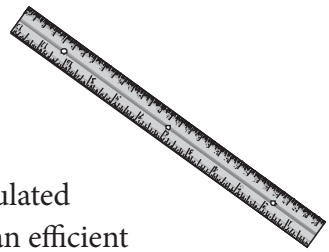
Name _____ *Date* _____

Drawing the Design



Directions: The grid below represents 100% of the doctor's entire 2000 ft^2 of office space. Because there are 100 squares, each square represents 1% of the whole. Using the percentages you calculated for each of the eight rooms on "Figuring the Dimensions," design an efficient office space. Show your work below.

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Math and Medicine:
Books and Web Sites

Books

- Ferris, J. *Native American Doctor: The Story of Susan LaFlesche Picotte*. Minneapolis, MN: Lerner Publishing Group, 1991.
  A biography of a young Omaha Indian woman who became the first Native American to obtain a medical degree.

- Henry, J. L. *Elizabeth Blackwell: Girl Doctor*. New York: Simon & Schuster Children's Publishing, 1996.
  This book tells the story of the first woman doctor in the United States, Elizabeth Blackwell. She worked in England and the United States and is credited with opening the field of medicine to women.

- Krohn, K. *Jonas Salk and the Polio Vaccine*. North Mankato, MN: Capstone Press, 2007.
  This book is a graphic nonfiction account of the discovery of the vaccine that prevented the dreaded polio virus. The full-color illustrations will be well-received by young readers. It tells the story of how, due to Jonas Salk's discovery, children and parents no longer have to live in fear of this deadly disease.

- Martin, A. M. *The Truth about Stacey*. New York: Scholastic, 1995.
  Stacey has diabetes and nobody knows but her friends in the Babysitters Club. The story chronicles Stacey's problem with her parent, who refuses to admit that she has the disease.

- Peacock, C. A., Gregory, A., and Gregory, K. C. *Sugar Was My Best Food: Diabetes and Me*. Morton Grove, IL: Albert Whitman, 2000.
  This is a story of an eleven-year-old boy who has just learned that he has diabetes. It tells the effects of the disease on his life and how he learned to cope with the changes he had to make.

- Stone, T.L. *Who Says Women Can't Be Doctors?: The Story of Elizabeth Blackwell.* New York: Henry Holt and Co., 2013.
  This book tells the story of a girl names Elizabeth Blackwell who grew up in the 1930's when everyone expected women to become wives and mothers. Some might become seamstresses or teachers but certainly no women were doctors. Elizabeth refused to accept the common belief that women weren't smart enough to become doctors, or that they were too weak for hard work. She wouldn't take no for an answer and despite all the opposition she faced she went on to have a brilliant career as a doctor.

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Math and Medicine:

Books and Web Sites (continued)

Web Sites

- www.cdc.gov/growthcharts
  This Web site contains many different charts that illustrate a child's growth over a period of time and uses percentiles as a means of comparison.

- www.nutri-facts.com
  Find the food labels of thousands of foods here—from baby foods to vegetables and vegetable products. It also contains calculators to compute Body Mass Index (BMI) and calorie intake.

- www.diabetes.org
  The home page for the American Diabetes Association has links to Diabetes Basic (describes types 1 and 2 diabetes, symptoms, and how to prevent it), Food and Fitness that explains what to eat and how to exercise.

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Math and Food Preparation

People who prepare food know that mathematics is very important to their work. Bakers talk about "formulas" rather than "recipes," chefs must understand weights and measures, portion control, recipe conversion, recipe yields, baking formulas, and much more.

As we explore the world of food preparation, we will see how basic computational skills, conversions, careful measurement, and problem solving play an important part in the success of this profession. Converting pounds to ounces and tablespoons to cups, finding percentages, calculating cost per serving, using ratio and proportion, and computing the menu cost are just some of the skills required by the food service professional.

Pastry chefs use a baker's percentage and their knowledge of mathematics to convert recipes to adjust the amount of ingredients—they can make 3 dozen cookies or 300 dozen cookies using the same formula—and the cookies will all taste exactly the same.

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Equivalent Weights and Measures

This table of equivalent weights and measures can be used to help you with any of the activities in this chapter.

1 pinch	=	$\frac{1}{8}$ teaspoon
3 teaspoons	=	1 tablespoon
4 tablespoons	=	$\frac{1}{4}$ cup
8 tablespoons	=	$\frac{1}{2}$ cup
12 tablespoons	=	$\frac{3}{4}$ cup
16 tablespoons	=	1 cup
2 cups	=	1 pint
4 cups	=	1 quart
16 cups	=	1 gallon
2 pints	=	1 quart
4 quarts	=	1 gallon
8 quarts	=	1 peck
8 fluid ounces	=	1 cup
16 ounces	=	1 pound
1 pound	=	1 fluid pint
2 pounds	=	1 fluid quart
8 pounds	=	1 fluid gallon
12 dozen	=	1 gross
32 ounces	=	1 quart
64 ounces	=	$\frac{1}{2}$ gallon
128 ounces	=	1 gallon

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Baking Raisin Muffins

Math Skills

- Converting measurements from customary to metric
- Reading a data table
- Computing percent of profit
- Solving problems

Materials Needed

- "Baking Raisin Muffins" activity sheet (p. 68) for each pair of students
- Calculators

Background Information and Suggested Teaching Strategies

Commercial bakers control portions with scoops, not spoons. Students may wonder why it is necessary to control portion size. Bakers do this for a number of reasons:

1. Using scoops provides uniform-sized muffins so they will all cook evenly.
2. There is less waste.
3. Costs can be better controlled because the number of muffins produced remains constant.
4. It takes less time to use scoops and so the cost of making muffins is reduced.

Using scoops allows the baker to control the size of each portion using volume. This activity asks students to use a table that lists 9 different sizes of scoops that range in volume from $1\frac{3}{4}$ tablespoon to $\frac{2}{3}$ of a cup and to calculate the number of muffins that can be made, the cost of each, their projected cost, and the percent of profit made.

Work with students to help them read and explain the information provided on the table.

It may be necessary to review the formula for finding the percentage of profit:

$$\text{Percentage of Profit} = \frac{\text{Difference between selling price and cost}}{\text{cost}} \times 100$$

Communicating through Journaling

Corn muffin batter is sold in 10-lb pails for $18.00. About how many muffins can be made using a #16 scoop that holds about $2\frac{1}{2}$ oz of batter? Be sure to explain how you solved this problem.

Answer: Students may use a variety of strategies to solve this problem but one possible solution is to first change pounds to ounces: 10 lbs = 160 oz. Then by dividing 160 oz by 2.5 oz (the number of ounces in 1 scoop), we find that 64 muffins of this size can be made from one pail.

Possible Extension Ideas

Give students the opportunity to write their own problems and share them with the class.

Activity Answers

If you use a #12 scoop:

1. You can make 96 muffins.
2. Each muffin will cost 37.5¢.
3. The percentage of profit is 300%.

If you use a #6 scoop:

1. You can make 57 muffins. The 0.6 ounces left over is wasted.
2. Each muffin costs approximately 63¢.
3. To make a 300% profit, one dozen should sell for approximately $30.24.

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Name _____ *Date* _____

Baking Raisin Muffins

When professional bakers make muffins, scoops or dippers are used to control the portion size and to make sure that the muffins look alike and are the same size. Scoops are numbered. The following table lists the scoops, their volumes, and the weight of the batter in one scoop of that size. One scoop is used to make one muffin.

Number	*Volume*	*Wt. (oz)*
6	$\frac{2}{3}$ cup	5
8	$\frac{1}{2}$ cup	4
10	$\frac{2}{5}$ cup	$3\frac{1}{2}$
12	$\frac{1}{3}$ cup	3
16	$\frac{1}{4}$ cup	$2\frac{1}{2}$
20	$3\frac{1}{5}$ tablespoon	$1\frac{2}{3}$
24	$2\frac{2}{3}$ tablespoon	$1\frac{1}{2}$
30	$2\frac{1}{5}$ tablespoon	$1\frac{1}{4}$
40	$1\frac{3}{4}$ tablespoon	1

Directions: As a food-service professional, you will need to calculate portions and how much you will charge for the muffins. Raisin muffin batter is sold in 18-pound (lb) pails for $36.00.

☞ ***If you use a #12 scoop:***

1. How many muffins can you make? _____

2. How much does each muffin cost? _____

3. If you sell them for $18.00/dozen, what percent of profit will you make? _____

☞ ***If you use a #6 scoop and make jumbo muffins***:

1. How many muffins can you make? _____

2. How much does each muffin cost? _____

3. If you want to make the same percent of profit as before, how much will you charge for each dozen jumbo muffins? _____

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Using the Baker's Percentage

Math Skills

- Calculating percentages and ratio and proportion
- Converting within the customary system (from pounds to ounces)
- Solving problems

Materials Needed

- Background Information sheet (p. 71) for each pair of students
- "Finding Percentages" activity sheet (p. 72) for each pair of students
- "Converting the Biscuit Recipe" activity sheet (p. 73) for each pair of students
- Calculators

Background Information and Suggested Teaching Strategies

It is important to remember that bakers weigh all of their ingredients for greater accuracy. The only ingredients that are not always weighed are water, milk, and eggs. For these three ingredients, the ratio bakers use is "one pint per pound."

Bakers use an ingenious system of percentages for expressing the "formulas" that they use. Baker's percentages express the amount of each ingredient used as a percentage of the weight of the flour used. By doing this, a recipe can be *scaled*, or adjusted, for any yield using exact proportions. To find the percentage of each ingredient, its total weight is divided by the weight of the flour, and this ratio is converted to a percent. The formula is:

$$\frac{\text{total weight of ingredient}}{\text{total weight of flour}} \times 100 = \% \text{ of ingredient}$$

Be sure to work with students to help them understand the steps necessary to scale the recipes in this activity:

1. Because we can only work if all of the ingredients are labeled using the same unit, all pounds must be changed to ounces. (Copy the table of equivalent measures at the beginning of this chapter for students.)
2. Review the procedures for converting a percent to a decimal and use that to find the percent of a number. For example: Suppose a recipe calls for 20% sugar and the chef will be using 10 pounds of flour. How much sugar will be needed?

   20% = 0.20

   10 lbs × 0.20 = 2 lbs of sugar

The Background Information page of this activity explains what a baker's percentage is and shows the formula used to calculate it. Read through the material on this page and go over the example. Go through each of the steps the chef went through to calculate the weight of each ingredient. Because the answers are shown, students have a self-checking exercise to begin to understand the steps required to use the baker's percentage formula.

After going over this page, try two different activities with students to practice this newly learned skill: The first requires students to find the percentage of each ingredient in a biscuit recipe; the second asks them to use the percentages to change the yield from 30 biscuits to 30 dozen!

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Communicating through Journaling

The recipe shown in the table is for white bread. Find the percent of each of the ingredients listed below (the flour is 100%).

Ingredient	*Weight*	*Percent*
flour	5 lbs	100
water	3 lbs	a.
yeast	3 oz	b.
salt	2 oz	c.
sugar	4 oz	d.
shortening	3 oz	e.
TOTAL YIELD	8 lb 12 oz or 140 oz	f.

Answers: 100% = 80 oz

a. 48 oz/80 oz = 60%

b. 3 oz/80 oz = 3.75%

c. 2 oz/80 oz = 2.5%

d. 4 oz/80 oz = 5%

e. 3 oz/ 80 oz = 3.75%

f. 140 oz = 175%

Possible Extension Ideas

If a local pastry chef or baker can visit the school, ask them to share their real-world experiences with students and explain how important mathematics is in their profession.

Activity Answers

Finding Percentages

Ingredient	*Weight*	*Percent*
flour	2 lbs 8 oz or 40 oz	100
salt	$\frac{1}{2}$ oz	**1.875**
sugar	2 oz	**5**
baking powder	$2\frac{1}{2}$ oz	6.25
shortening	14 oz	**35**
milk	1 lb 10 oz or 26 oz	**65**
TOTAL YIELD	**5 lbs $5\frac{1}{4}$ oz or 85.25 oz**	213.125

Converting the Biscuit Recipe

1. 1 lb or 16 oz

2. 30 lb

3. 30 x 16 or 480 oz

Ingredient	*Weight*	*Percent*
flour	**30 lbs or 480 oz**	100
salt	**9 oz**	**1.875**
sugar	**1 lb 8 oz or 24 oz**	**5**
baking powder	**1 lb 14 oz or 30 oz**	6.25
shortening	**10 lbs 8 oz or 168 oz**	**35**
milk	**19 lbs 8 oz or 312 oz**	**65**
TOTAL YIELD	**63 lbs 15 oz or 1,023 oz**	213.125

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Background Information

Did you know that bakers *weigh* everything that they put into a recipe? When we bake, we measure everything by volume—3 cups of flour, 1 tablespoon of butter, and so on. Professional bakers use 1.5 pounds of flour or .5 ounces of butter. But measuring by volume is not accurate enough for professional bakers. They even call their recipes "formulas" because they are so accurate!

Also bakers use a unique system of percentages for expressing the quantity of each of the ingredients in a recipe. Baker's percentages express the amount of each ingredient used as a percentage of the amount of flour used. In most recipes, flour is considered 100% of the recipe and the weight of every other ingredient is compared to its weight. They use the following formula:

$$\frac{\text{total weight of ingredient}}{\text{total weight of flour}} \times 100 = \%\text{ of ingredient}$$

For example, suppose a biscuit recipe calls for 2 pounds 8 ounces ($2\frac{1}{2}$ pounds) of flour; remember the flour represents 100%. The rest of the recipe uses both pounds and ounces; to use the formula shown above, the numerator and the denominator must be expressed with the same label (ounces to ounces). This requires you to convert the pounds (lbs) to ounces (oz): 16 oz × 2.5 lbs = 40 oz. This recipe calls for 2.5 oz of baking powder, so the percentage of baking powder to flour is:

$$\frac{2.5\text{ oz}}{40\text{ oz}} \times 100 = 6.25\,\%$$

By using this same procedure, we can calculate the percentage that each ingredient represents in this recipe. That way, when we want to convert the recipe to yield a different number of biscuits, we can use the percentages to find how much of each ingredient we will need.

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Finding Percentages

Directions: Use the Baker's Percentage to convert each of the ingredients in this recipe to percent of flour. Then, when you want to change the yield (from $2\frac{1}{2}$ dozen to another quantity) you can use percentages to obtain the most accurate recipe. The total yield percentage for this recipe is 213.125%. You will need this information later on.

Biscuit Recipe

Makes $2\frac{1}{2}$ dozen

flour	2 lbs 8 oz or 40 oz
salt	$\frac{3}{4}$ oz
sugar	2 oz
baking powder	$2\frac{1}{2}$ oz
shortening	14 oz
milk	1 lb 10 oz or 26 oz

Ingredient	*Weight*	*Percent of flour*
flour	2 lbs 8 oz or 40 oz	100
salt	$\frac{3}{4}$ oz	
sugar	2 oz	
baking powder	$2\frac{1}{2}$ oz	6.25
shortening	14 oz	
milk	1 lb 10 oz or 26 oz	
TOTAL YIELD		213.125

Use this space to show your work:

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Converting the Biscuit Recipe

When bakers need to convert a recipe (to increase or decrease the size), they use the percentages in a very interesting way!

Directions: Solve the following problems.

1. We know from the previous page that the 40 ounces of flour made $2\frac{1}{2}$ dozen biscuits. How many ounces of flour was used for each dozen biscuits? _____
2. Suppose a professional baker wants to make 30 dozen biscuits to serve as part of a Sunday brunch. What is the weight of the flour he will need to make this many biscuits? _____
3. How many ounces of flour will he need? _____

This is considered 100% of our new recipe. Copy the percents from your other activity sheet onto this table. (Two have already been entered for you.) Remember, the percentages remain the same, only the weights differ!

Now find the percentage of each of the other ingredients and enter them on to this table.

Ingredient	*Weight*	*Percent of flour*
flour		100
salt		
sugar		
baking powder		6.25
shortening		
milk		
TOTAL YIELD		213.125

Show your work here:

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Percentages in a Side of Beef

Math Skills

- Finding percentages
- Rounding, solving problems

Materials Needed

- "Percentages in a Side of Beef" activity sheet (p. 75) for each student
- Calculators

Background Information and Suggested Teaching Strategies

Discuss with students how different cuts of meat cost different amounts per pound. Use a newspaper with the grocery ads to show students what the meats cost on sale at a local market.

Before students get started, have them compute the total weight of the side of beef. It may be necessary to work with some of the students to review how to find percent and how they might wish to round their answers. If students round each of their answers to the nearest percent, the total percent will be 101%.

Communicating through Journaling

1. If a total side of beef weighs 235 lbs and the chuck portion is 27% of the total weight, how much did the chuck portion weigh in pounds?
2. The sirloin portion of that same side of beef weighs 20 lbs. What percent of the total weight is the sirloin portion?

Answers:

1. 27% of 235 lbs = 63.45 lbs or approx. $63\frac{1}{2}$ lbs
2. 20 lbs = approx. 8.5% of 235 lbs

Possible Extension Ideas

Students can research the cost of each of these cuts of meats in the local market and analyze their costs, how the cost relates to the percentages found in this activity, and what other factors might affect the cost of each of the cuts of meat.

Activity Answers

1. 221 lbs
2. These answers have been rounded to the nearest percent:
   a. 27%
   b. 11%
   c. 9%
   d. 7%
   e. 23%
   f. 5%
   g. 7%
   h. 7%
   i. 5%
3. 101%
4. No. Rounding the answers to the nearest percent caused the slight error.

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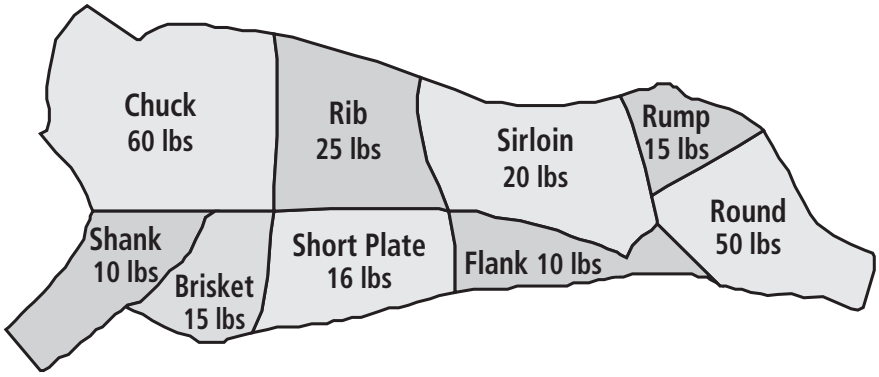
Percentages in a Side of Beef



Directions: A side of beef is half of a cow. It is divided into cuts and the cost of the meat depends on how tender the meat is and how much of it is on the carcass. The diagram above shows the cuts of beef. Use this diagram to help you answer the following questions.

1. What is the total weight of the side of beef? _____

2. Find the percentage of each of the cuts of beef that make up the side shown above.

a. chuck _____ f. shank _____

b. rib _____ g. brisket _____

c. sirloin _____ h. short plate _____

d. rump _____ i. flank _____

e. round _____

3. What is the total percentage? _____

4. Did the percentages of this side of beef add up to 100%? _____

If not, explain why they didn't. _____

_____

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Edible Portion and Serving Size

Math Skills

- Problem-solving to calculate percents
- Converting within the customary system
- Estimating answers

Materials Needed

- "Edible Portion and Serving Size" activity sheet (p. 78) for each student
- Calculators

Background Information and Suggested Teaching Strategies

There are actually two parts to this lesson. The first asks students to calculate the edible portion of meats after they have been trimmed and boned; the second has students calculate serving size and costs.

Discuss with students that meat is sold at wholesale prices to chefs. *Wholesale* means selling something in large quantities at discounted prices. Chefs order meat in two ways—A.P (as purchased) or E.P. (edible portion). Sometimes these two measures are the same. For example, if a chef buys ground beef that is 80% lean, he or she need only use it in a recipe; no further work is required to process the meat. But suppose a chef buys steak that needs to be trimmed. If a 20-lbs roast needs to be trimmed and boned, it is possible for a percentage of the meat to be lost on the cutting board. In this case, the A.P. and the E.P. will differ. Discuss with students why the cost of each serving *must* be calculated on the A.P. rather than the E.P. It may also be necessary to review with students how to calculate the percentage of loss:

$$\frac{\text{amount of loss}}{\text{original weight}} \times 100 = \%\text{ of loss due to processing}$$

To calculate number of servings, students need only divide the E.P. weight by each portion size.

Communicating through Journaling

How many pounds of ground beef must be ordered to serve spaghetti and meatballs to 130 people if each person is to get two $2\frac{1}{2}$ -oz meatballs? Be sure to show all of your work.

Answer: Different strategies can be used to solve this problem but one way is to calculate the total number of ounces needed to feed 130 people and then convert that to pounds: $2 \times 2.5 \times 130 = 650$ oz; $650 \div 16 = 40.625$ lbs. To be safe, the chef would probably order 41 lbs of beef.

Possible Extension Ideas

If you can obtain scales, you can demonstrate for students the concept of A.P. (amount purchased) and E.P. (edible portion). Purchase a boneless roast that has not been trimmed. Ask the butcher to weigh and price the meat without trimming. To begin the demonstration, ask students, "What percentage of the meat do you think will be lost when I trim the fat from this meat?" Write down estimates, and then weigh the meat. After the meat is trimmed to the class's satisfaction, reweigh the piece of meat and calculate the percent of loss and the E.P. Ask students, "If each person received the same size portion of this meat, how many ounces will each person get?"

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Activity Answers

1. a. 7%

b. 17 filets (There will be 2 oz left over, but that is not a full serving.)

2. a. 25%

b. 48 patties

3. a. 246 oz (288 oz–42 oz)

b. 15%

c. 20 steaks (There will be 6 oz left over.)

d. $5.40 (Remember that the chef has to calculate using the A.P. costs.)

e. It is possible that because of the rounding, students will come up with answers anywhere between $16 and $17. Using the equation $\frac{1}{3x} = \$5.40$, students calculate $16.20 for the lowest price, but they may feel that this is an unrealistic amount to charge and round the number.

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Name _____ *Date* _____

Edible Portion and Serving Size

When food-service professionals buy their meat, they do not go to the supermarket and get the meat in a nice cellophane wrapper already weighed and priced. When they buy it, they need to trim off the fat (called *trimming*) and bone (called *boning*), and so some of the meat is wasted. They have a formula to explain the mathematics behind this problem and help them calculate their costs:

Amount Purchased (A.P.) – Waste = Edible Portion (E.P.)

Directions: Use the formula to solve the following problems.

1. A chef purchases 7 pounds of beef tenderloin (A.P.). He loses 8 ounces to trimming.

a. What percentage of the meat is lost after trimming? _____

b. How many 6-ounce filets can be cut from the tenderloin? _____

2. When preparing pork sausage, a chef buys 16 pounds (A.P.) of pork. One-fourth is lost to boning and trimming.

a. What percentage is lost to boning and trimming? _____

b. How many 4-oz patties can be formed? _____

3. Suppose a chef purchases an 18-pound sirloin of beef (A.P.) that costs him $6 per pound. He loses 2 pounds 10 ounces during boning and trimming.

a. What is the E.P.? _____

b. What percentage of the meat is lost after boning and trimming? _____

c. How many 12-ounce steaks can be cut from this sirloin? _____

d. How much will each steak cost the chef? _____

e. If the chef wants his food costs to be no more than $\frac{1}{3}$ of the selling price, figure the least amount this steak should cost on the menu. Explain how you solved this problem. _____

_____

_____

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How Much Food to Order?

Math Skills

- Converting within the customary system of measurement
- Computing and solving problems with whole numbers and fractions

Materials Needed

- "How Much Food to Order?" activity sheet (p. 80) for each student
- Calculators

Background Information and Suggested Teaching Strategies

The arithmetic involved in calculating how many cans, boxes, or packages of certain food items are needed or must be opened to feed a certain amount of guests is essential for those people involved in the preparation and presentation of food. There are three variables involved in these calculations: the serving size of each portion; the quantities, weight, or sizes of the foods to be served are sold; and the number of people to be served.

One of the problems refers to a #5 can. It is interesting to note that regardless of whether it is an institutional-sized can or one that is on the shelf of a supermarket, most cans are produced to hold a specific quantity of foods. The table at top right shows the approximate capacities of some of the commonly used sizes of cans. Weights of actual cans may vary depending on the contents of the can.

The problems in this activity ask students to perform arithmetic operations that are commonly found in traditional textbook materials. However, relating them to a food industry career encourages students to see the relevance of the mathematics.

Approximate Equivalents of Can Sizes

# of Can	*Volume*	*Example of Contents*
#300	$15\frac{1}{2}$ oz	pork & beans, cranberry sauce
#303	1 lb	most vegetables & fruits
#2 $\frac{1}{2}$	1 lb 13 oz	tomatoes, pumpkin, sauerkraut
#3	48 oz	fruit juices
#5	56 oz	institutional pack—fruit juices
#10	12 cups	institutional pack—fruits & vegetables

Communicating through Journaling

How many $2\frac{1}{2}$-lb bags of corn are needed to serve 350 people at a party if each person receives a 4-oz serving? Be sure to show your work.

Answer: Different strategies can be used, but one way is to calculate the total number of ounces needed to feed 350 people and then convert the $2\frac{1}{2}$-lbs bags to ounces and divide: $350 \times 4 = 1400$ oz. 2.5 lbs = 40 oz; $1400 \div 40 = 35$ bags of corn.

Possible Extension Ideas

Give students a copy of the table of can sizes and have them:

1. Collect data at a local market listing the kinds of foods that are found in cans of this size
2. Compare the cost per ounce of foods in different-sized cans—are they saving money by buying a larger-sized can of food?

Activity Answers

Most of these problems show students the relevance of rounding up to the next higher number when there is a remainder in a division problem.

1. 21 cans
2. 141 lbs
3. 11 boxes
4. 3 pails
5. 32 cakes

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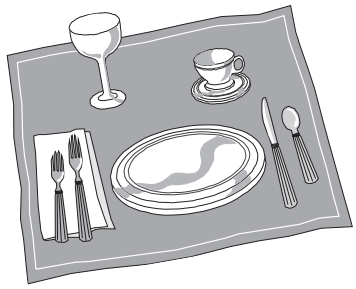
How Much Food to Order?



To keep food costs down, food-service professionals must be careful that they don't order too little or too much food. Why do you think this is true? To order the correct quantities, the chef must know in advance how large each portion is going to be. These serving sizes must be adhered to!

Directions: This is a menu for a dinner that is being planned for 250 people. Your job is to figure out how much of each of the major food items must be ordered.

MENU

TOMATO JUICE

ROAST SIRLOIN OF BEEF

PEAS AND PEARL ONIONS

MASHED POTATOES

CHOCOLATE CAKE

1. The tomato juice is sold in #3 cans—each can contains 48 fluid ounces. Each person will get a 4-ounce serving. How many cans of juice must be purchased? _____

2. How many pounds of sirloin of beef (E.P.) must be ordered if each person is to receive a 9-ounce portion? _____

3. How many 5-pound (lb) boxes of frozen peas and pearl onions must be purchased if each person is to receive a $3\frac{1}{2}$-ounce (oz) serving? _____

4. How many 3-gallon pails of mashed potatoes must be purchased if each person is to receive one #8 scoop ($\frac{1}{2}$ cup)? ***Hint:*** There are 16 cups in 1 gallon. _____

5. Each 12-inch cake will be cut into 8 servings. How many cakes must be purchased? _____

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Pattie's Pizza Parlor

Math Skills

- Finding the area of circles
- Calculating unit costs
- Estimating
- Calculating percent and combinations
- Solving problems

Materials Needed

- "What's the Area?" activity sheet (p. 83) for each pair of students
- "Flavors and Combinations" activity sheet (p. 84) for each pair of students
- Calculators

Background Information and Suggested Teaching Strategies

These two activities focus on topics that are important in the middle-school curriculum. The first page asks students to apply their knowledge of finding the area of circles to problem solve if buying a larger-sized pizza is the better buy. The second activity ask students to apply arithmetic skills to calculate the cost of pizzas (with various numbers of toppings), calculate sales tax, share the cost of a check, use "easy percent" to estimate the amount of a tip, and validate an advertisement by calculating the number of different 2-topping pizzas of three different sizes Pattie's Pizza Parlor can make!

There is a formula for computing combinations of things taken so many at a time, it is often memorized and, therefore, easily forgotten. The formula for finding the number of combinations of 10 items taken 2 at a time is:

$$ {}_nC_r = \frac{n!}{(n-r)!*r!} \cdot {}_{10}C_2 = \frac{10!}{(10-2)!*2!} = \frac{10\times9\times8\times7\times6\times5\times4\times3\times2\times1}{(8\times7\times6\times5\times4\times3\times2\times1)!*2\times1} = \frac{10\times9}{2\times1} = \frac{90}{2} = 45 $$

Using this formula, we see that there are 45 possible combinations for each size of pizza. This solution is provided as background information only and it is not recommended that it be used with middle-school students unless they are enrolled in advanced algebra classes. Another interesting strategy to find combinations is to use a matrix, such as the one shown in the Activity Answers section on the next page.

Communicating through Journaling

Gianna's Pizzas charges $9.50 for a medium pizza and $1.20 for each additional topping. Pattie's Pizza Parlor charges $9.00 for a medium pizza and $1.30 for each additional topping. If you ordered a three-topping pizza, would it cost you less at Gianna's or at Pattie's? Explain your answer and show your work.

Answer: At Gianna's, a 3-topping pizza will cost $9.50 + $3.60 or $13.10. At Pattie's, a 3-topping pizza will cost $9 + 3.90 or $12.90. It will be 20¢ cheaper at Pattie's.

Possible Extension Ideas

Use the information given above on the Journal question regarding the cost of pizza at Gianna's Pizza and Pattie's Pizza Parlor. Ask students to design a graph to show the cost of pizza at both restaurants for a one-topping pizza, a two-topping pizza, a three-topping pizza, and so on to problem-solve at what point it will be cheaper to go to Gianna's than Pattie's. By using a table and a double-line graph (with two different colors), students can solve this problem.

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Activity Answers

What's the Area?

These answers have been rounded to the nearest whole number.

1. a. ≈ 79 in^2

b. ≈ 7¢/ in^2

2. a. ≈ 154 in^2

b. ≈ 6¢/ in^2

3. a. ≈ 201 in^2

b. ≈ 5¢/ in^2

4. The large pizza is a better buy because it costs about 5¢ per in^2.

Flavors and Combinations

These answers have been rounded to the nearest penny.

1. a. $6.90

b. $0.41

c. Because it is $3.655, one person will pay $3.65 and the other $3.66.

2. a. $10.92

b. about $1.00; $0.50, $1.50; Students may use different strategies. One possible solution is to calculate 10%, take half of that (5%), and add the two numbers together (10%, or $1 + 5% or 50¢ = 15% or $1.50).

3. The advertisement is true. There are 45 ways to order a two-topping pizza, and because there are three different sizes, there is a total of 135 different combinations (2 years 31 weeks).

The matrix shown below is an interesting strategy to use with middle-school students. The shaded area eliminates those combinations in which either the toppings are the same (such as pepperoni-pepperoni, or PP) or repeats (for example, PS is the same as SP). Ingredients are listed in the same order as they appear in the "topping table" on the activity sheets.

	P	***S***	***O***	***M***	***RP***	***Ol***	***Sp***	***B***	***C***	***Pi***
P	PP	PS	PO	PM	PRP	POl	PSp	PB	PC	PPi
S	SP	SS	SO	SM	SRP	SOl	SSp	SB	SC	SPi
O	OP	OS	OO	OM	ORP	OOl	OSp	OB	OC	OPi
M	MP	MS	MO	MM	MRP	Mol	MSp	MB	MC	MPi
RP	RPP	RPS	RPO	RPM	RPRP	RPOl	RPSp	RPB	RPC	RPPi
Ol	OlP	OlS	OlO	OlM	OlRP	OlOl	OlSp	OlB	OlC	OlPi
Sp	SpP	SpS	SpO	SpM	SpRp	SpOl	SpSp	SpB	SpC	SpPi
B	Bp	BS	BO	BM	BRP	BOl	BSp	BB	BC	BPi
C	CP	CS	CO	CM	CRP	Col	CSp	CB	CC	CPi
Pi	PiP	PiS	PiO	PiM	PiRP	PiOl	PiSp	PiB	PiC	PiPi

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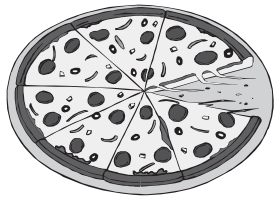
What's the Area?



Buying pizza can be very confusing. Look at all of the choices in size and toppings—which is the best buy? Let's examine a menu from Pattie's Pizza Parlor and use our math skills to answer some of these questions.

PIZZA SIZES	*Small: 10″*	*Medium: 14″*	*Large: 16″*
Tomato Sauce & Cheese	$5.50	$9.00	$11.00
Extra Toppings	$ .70	$1.30	$ 1.80
# of Slices	6	12	16

Toppings:
pepperoni, sausage, onions, mushrooms, red peppers, olives, spinach, broccoli, chicken, pineapple

To calculate how much each slice of pizza costs, we must have some way of comparing their sizes. If we find the total surface area of each whole pizza and then divide by the number of slices, we learn the size of each slice. Once we know the size of each slice, finding the cost of each slice is simple arithmetic. The formula we use to calculate area is: $A = \pi r^2$. Find the area of each pizza and then the cost of each slice. There are no toppings added to our pizza. Use 3.14 for π.

1. a. The area of the small pizza (in square inches, in^2) is: _____

b. The cost per square inch of this size pizza is: _____

2. a. The area of the medium pizza (in in^2) is: _____

b. The cost per square inch of this size pizza is: _____

3. a. The area of the large pizza (in in^2) is: _____

b. The cost per square inch of this size pizza is: _____

4. Which size is the best buy? _____Why? _____

_____

Use this space to show all of your work and explain how you solved these problems:

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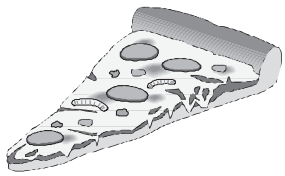
Flavors and Combinations



How much does adding toppings add to the cost of the pizza? How many different kinds of one or two-topping pizzas can we order at Pattie's Pizza Parlor? We can use our math skills to help us find the answers to these problems.

PIZZA SIZES	*Small: 10"*	*Medium: 14"*	*Large: 16"*
Tomato Sauce & Cheese	$5.50	$9.00	$11.00
Extra Toppings	$ .70	$1.30	$ 1.80
# of Slices	6	12	16

Toppings:
pepperoni, sausage, onions, mushrooms, red peppers, olives, spinach, broccoli, chicken, pineapple

1. a. How much would a 10" pizza with pepperoni and mushrooms cost? _____

b. The tax in this town is 6%. How much tax would be added to the cost? _____

c. If two people shared this pizza, what is each person's cost? _____

2. a. How much would a medium pizza with one topping cost (including sales tax)? _____

b. Estimate 10% of the cost of the pizza (before tax) _____ .

What is 5%? (just take half of 10%) _____ .

The wait staff usually receives a tip of about 15%. Explain how you can use the "easy percent" shown above to estimate a 15% tip. _____

_____

3. Pattie advertises that you could order a different two-topping pizza once each week for about $2\frac{1}{2}$ years and never get the same pizza. Do you think her advertisement is true? _____ Show your work here:

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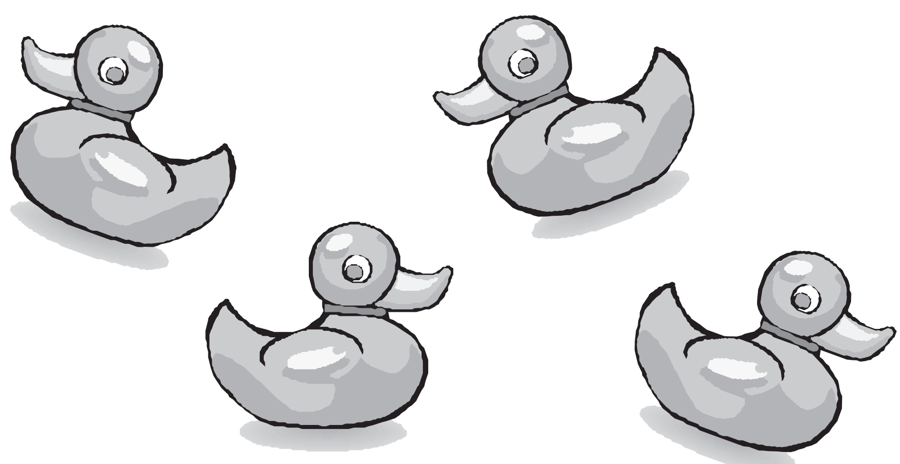
Name ______________________________ *Date* ______________

A Food Joke Puzzle

What do you get when you put four ducks in a box?

Solve each of these measurement problems by matching each measure with its equivalent at the bottom of the page. Then place the letter of the problem above its matching equivalent at the bottom of the page to learn the answer to the food joke.

F 2 pints	**B** 2 cups	**S** 4 tablespoons	**Q** 4 quarts	**A** 8 ounces	**X** 64 ounces
C 8 quarts	**O** $\frac{1}{8}$ teaspoon	**R** 1 gross	**K** 3 teaspoons	**E** 8 tablespoons	**U** 12 tablespoons



1 cup		**1 pint**	**1 pinch**	**$\frac{1}{2}$ gallon**		**1 pinch**	**1 quart**		**1 gallon**	**$\frac{3}{4}$ cup**	**1 cup**	**1 peck**	**1 tablespoon**	**$\frac{1}{2}$ cup**	**12 dozen**	**$\frac{1}{4}$ cup**

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Name _____ *Date* _____

Food Preparation Word Search

Directions: Find the words shown at the bottom of the page. They can be found either across, up-and-down, or on the diagonal.

C	O	O	K	I	E	S	Q	T	N	N	L	O	U	A
X	T	A	D	G	Y	U	N	O	O	P	S	A	E	T
S	A	F	R	E	Y	C	U	P	T	L	O	I	I	K
W	B	T	W	E	I	G	H	T	N	O	O	M	U	G
C	L	V	N	T	R	N	E	E	O	R	E	K	A	B
H	E	B	P	M	U	I	T	E	L	Y	B	X	M	Q
E	S	I	C	V	C	K	M	J	L	U	I	E	K	L
F	P	S	A	S	R	O	T	B	A	V	A	N	L	Q
Z	O	C	E	R	R	O	O	L	G	S	M	B	E	C
K	O	U	T	T	W	C	O	P	U	C	V	N	Y	A
A	N	I	F	R	R	P	L	R	F	P	I	N	T	K
E	E	T	I	I	L	N	E	O	I	C	W	T	R	E
U	R	E	R	E	T	A	C	I	L	N	N	E	E	C
F	D	E	D	W	Q	U	Y	R	T	S	A	P	Y	T
L	R	Q	U	A	R	T	T	S	M	B	E	E	C	U

COOKIES
TABLESPOON
TEASPOON
PINT
MEASURE
COOKING
WEIGHT
BISCUIT
CHEF
BAKER
CATERER
PASTRY
QUART
GALLON
CUP
CAKE

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Puzzle Answers

A Food Joke Puzzle

A		B	O	X		O	F		Q	U	A	C	K	E	R	S
1 cup		1 pint	1 pinch	$\frac{1}{2}$ gallon		1 pinch	1 quart		1 gallon	$\frac{3}{4}$ cup	1 cup	1 peck	1 tablespoon	$\frac{1}{2}$ cup	12 dozen	$\frac{1}{4}$ cup

Food Preparation Word Search

C	O	O	K	I	E	S								
	T						N	O	O	P	S	A	E	T
	A					C	U	P						
	B		W	E	I	G	H	T	N					
C	L					N			O	R	E	K	A	B
H	E	B				I			L				M	
E	S	I				K			L			E		
F	P	S				O			A		A			
	O	C				O			G	S				C
	O	U				C			U					A
	N	I						R		P	I	N	T	K
		T					E							E
	R	E	R	E	T	A	C							
							Y	R	T	S	A	P		
		Q	U	A	R	T								

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Math and Food Preparation:

Books and Web Sites

Reference Books

- Bader, Dr. M. H. *6001 Food Facts and Chef's Secrets*. San Diego, CA: Mylin Publishing, 1995.
  This book is jam-packed with thousands of food, beverage, vitamin and mineral, and supermarket facts, as well as hundreds of chef's secrets.

- Gisslen, W. *Professional Baking*. 6th ed. New York: John Wiley & Sons, 2012
  Written to be used by bakers and pastry chefs, this book is filled with the "formulas" that are used by bakers to assure that regardless of how a recipe is scaled, it will always taste the same. It contains a wealth of data that can be used by mathematics teachers to demonstrate that people "do use math in the real world."

- Strianese, A.J. *Math Principles for Food Service Occupations*. Independence, KY: Delmar Cengage Learning, 2011
  This book stresses the direct relevance of math skills in the food service industry while teaching the basic math principles that affect everything from basic recipe preparation to managing food and labor costs in a restaurant operation. All the mathematical problems and concepts presented are explained in a simplified, logical, step-by-step manner.

Books for Students

- Better Homes & Garden. *New Junior Cookbook*. NY: Better Homes & Gardens, 2004
  Written and designed to appeal to kids ages 5 to 12. All the recipes are easy-to-follow and packed with helpful hints and fun ways for kids to put their own spin on them. With lots of easy-to-understand nutrition information, it's a great way to teach kids about healthy eating while getting them interested in cooking.

- D'Amico, J., and Drummond, K. E. *The Math Chef: Over 60 Math Activities and Recipes for Kids*. New York: Jossey-Bass, 1996.
  This book contains more than 60 activities and recipes that encourage students to practice math while they cook.

- Greenberg, D. *Misfortune Cookie*. New York: Penguin Young Readers Group, 1998.
  Zach visits a Chinese restaurant named "Dum Guy" and strange things start happening—the fortunes in the fortune cookies start coming true!

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Math and Food Preparation:

Books and Web Sites (continued)

- Hartland, J. *Bon Appetit!! The Delicious Life of Julia Child*. NY: Schwartz & Wade, 2012
  This adorable and unique book follows Julia Child—chef, author, and television personality— from her childhood in California, to her life as a spy in WWII, to the cooking classes she took in Paris and finally to the funny moments she encountered a chef on T.V.

Web Sites

- http://home.comcast.net/~askpauline/math/mathandfood.html
  Pauline Harding's math page gives 44 ideas for mixing food and math.

- http://illuminations.nctm.org/LessonDetail.aspx?id=U78
  The National Council of Teacher's of Mathematics web site, Illuminations, lists two activities:

  1) "Beverage Sharing and Serving"— which appeared in in the February 1994 *The Arithmetic Teacher*, Vol. 41, No. 6, pp. 309-10, 313-14. Students determine, using a nonstandard cup or plastic drinking container, the minimum amount of fruit drink needed to serve class members.

  2) "A Brownie Bake" Students determine the amount of each ingredient needed to make brownies, and then they figure out how to divide the brownies evenly among their classmates. This lesson helps students reinforce their measurement skills in a practical situation.

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Math at the Zoo

More than 100 million people visit zoos annually, and the people who take care of the animals have a 24-hour, 7-day-a-week job! The zoo professionals have to be able to make detailed observations, keep up-to-date information about the animals in their care, and educate the public about the critical need for the conservation of wildlife and their habitats.

There are many different kinds of jobs in today's zoos—some require business degrees and accounting skills while others require training in animal sciences, such as zoology, conservation biology, wildlife management, veterinary medicine, and animal behavior.

The people who have direct contact with animals on a daily basis are the zookeepers. This is hard work because these people are responsible for feeding the animals, taking care of their living spaces, and keeping them healthy. Zookeepers need to be observant, keep detailed notes about animal behaviors, regulate animals' diets, and help with necessary research.

Mathematics at the zoo is varied and interesting. In addition to being good problem solvers, zoo workers need to be keen observers and collect important data. They keep track of trends using graphs and charts, prepare meals based upon nutritional concerns, and are familiar with both the metric and customary systems of measurement. The activities in this chapter will focus on the amazing attributes of animals.

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Lion Cub Math

Math Skills

- Reading tables and charts
- Graphing
- Using computation to calculate percent of increase and solve problems

Materials Needed

- "Graphing Their Weight" activity sheet (p. 93) for each student
- "The Cost of Feeding" activity sheet (p. 94) for each student
- "How Much Does It Cost?" activity sheet (p. 95) for each student
- Calculators (optional)
- Colored pencils (optional)

Background Information and Suggested Teaching Strategies

The data contained in this activity were obtained from the Lincoln Park Zoo in Chicago, Illinois. You'll be working with the actual weights and food consumption of two male lion cubs. This activity consists of three different lessons.

The first activity sheet contains a table that shows the weights of the two cubs during the first $8\frac{1}{2}$ months of their lives. At birth, one of the cubs is heavier than the other and, as he gains weight, he continues to outweigh his smaller brother. While the growth rates are not linear, they do continue at a rather steady increase.

The second activity is much more dramatic. For the first 3 months of a cub's life, he lives on mother's milk. At 3 months cubs start to take in very small quantities of meat cut into very small pieces so that cubs can chew and digest it. At about 6 months of age, the cub consumes 1,500% more food than he did at 3 months! When the lion reaches adulthood, the amount of food he consumes stabilizes.

The last activity asks students to calculate the cost of feeding each cub during the first 18 months of their lives.

It is important to go over tables with students to be sure that they understand the data. Also, it might be more effective if students graph the weights of the two cubs in the activity using different-colored pencils.

Communicating through Journaling

A 3-month-old cub eats about $\frac{1}{2}$ lb of meat per day. At 1 year, he eats about $8\frac{1}{2}$ lbs of meat per day. What is the percent of increase? Explain how you solved this problem. Be sure to show your work.

Answer:

$$\text{Percent of increase} = \frac{\text{amount of increase}}{\text{original amount}} \times 100;$$

$$\text{Percent of increase} = \frac{8}{.5} \times 100 = 1{,}600\%$$

Possible Extension Ideas

If possible, take a focused field trip to a local zoo and make an appointment to meet with a zookeeper and discuss his or her job. It is not necessary for the zookeeper to care for the lions—perhaps there has been a recent birth in the zoo and the keeper of these babies is available to share some data with students.

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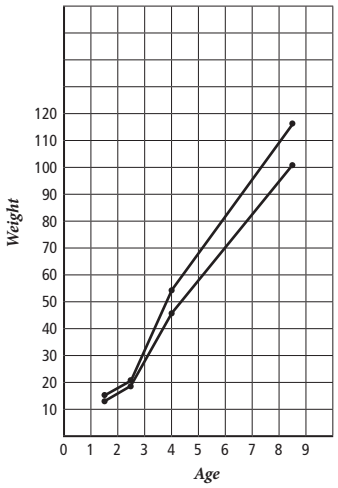
Activity Answers

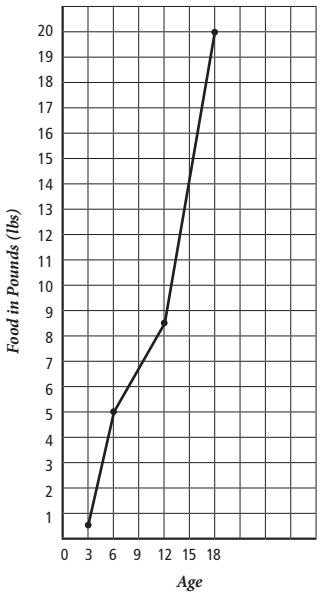
Graphing Their Weight

Depending on the units students use, the graph will look similar to this one:



The Cost of Feeding

Depending on the units students use, the graph will look similar to this one:



Students are asked to describe the shape of the data for each of the two graphs. In the first activity, although there is a jump in the amount of food consumed between ages 3 and 4, the graph is almost linear. It should also be noted that the difference between the graphs of the two lions remains the same.

In the second activity, the difference in the cost of the food produces a very dramatic graph (appearing to be almost exponential in nature).

How Much Does It Cost?

Age of Lion	Cost per Day	Cost per Week	Cost per Month (30-days)
3 months old	$1.15	$ 8.05	$34.50
6 months old	11.45	80.15	343.50
1 year old	19.47	136.26	583.95
Adult: 18 months old	45.80	320.60	1,374.00

1. $4,122.00

2. 3,883%. The formula is:

$$\text{Percent of increase} = \frac{\text{difference in cost}}{\text{original cost}} \times 100 = \frac{44.65}{1.15} \times 100$$

3. Students may have different, although quite valid, responses to this question. They might want to do some research to find possible answers.

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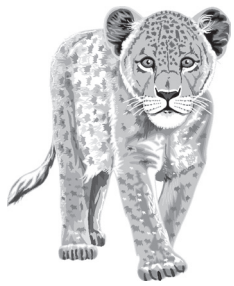
Name _____ *Date* _____

Graphing Their Weight



Two male lion cubs were born at the zoo this year; their weights, and those of their mother and father, were on display in the Lion House.

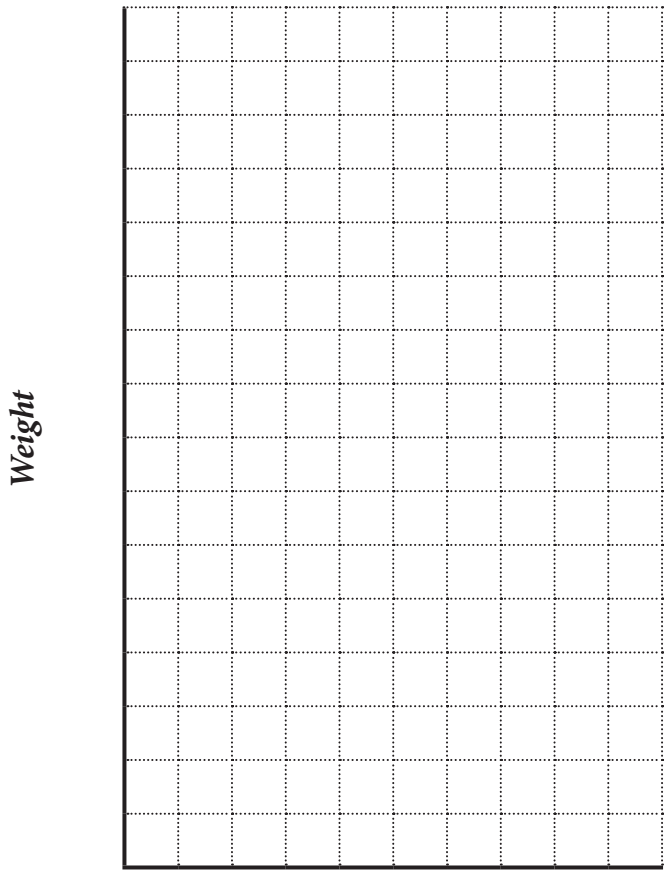
Age	*Cub 1*	*Cub 2*
$1\frac{1}{2}$ months	15.2 lbs	13.4 lbs
$2\frac{1}{2}$ months	20.3 lbs	19.0 lbs
4 months	54.3 lbs	46.2 lbs
$8\frac{1}{2}$ months	117.2 lbs	101.8 lbs

Female Parent
270 pounds (lbs)

Male Parent
371 pounds (lbs)

Use this graph to record the growth of each of the lion cubs. Describe the shape of the data.

_____



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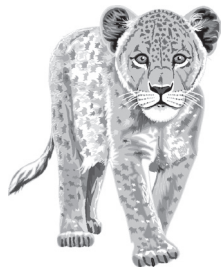
Name _____ *Date* _____

The Cost of Feeding

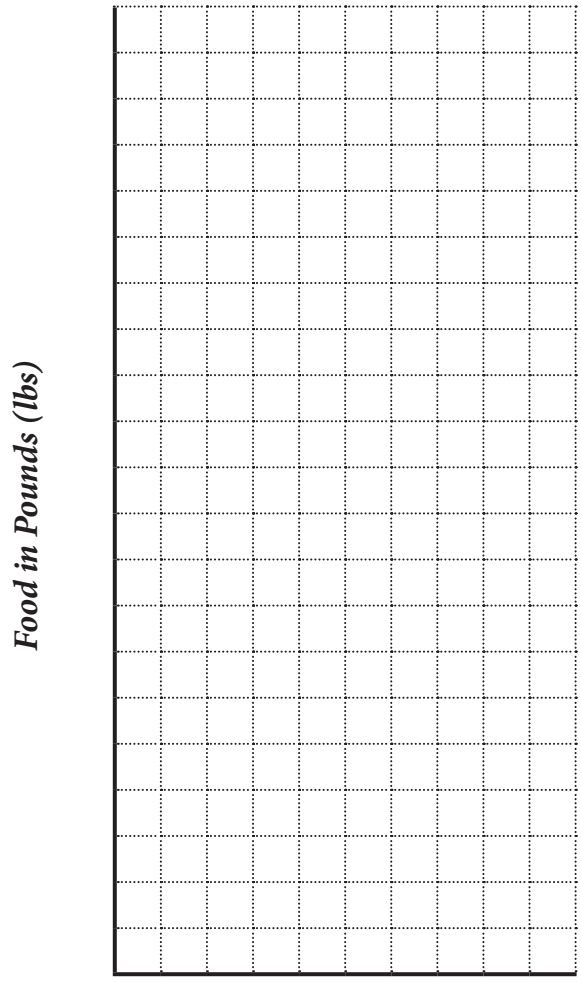


Lion cubs start to nibble on meat at about 3 months. Once they start to eat solid foods on a regular basis, the amount of meat increases rapidly. The chart is an example of the amount of meat lion cubs might eat on average per day.

Age	3 months	6 months	1 year	Adult: 18 months
Meat (in lbs)	$\frac{1}{2}$ lbs	5 lbs	$8\frac{1}{2}$ lbs	20 lbs

Use the grid below to draw a graph of the food consumption of a lion cub. Describe the shape of the graph. What do you think it shows? _____

_____



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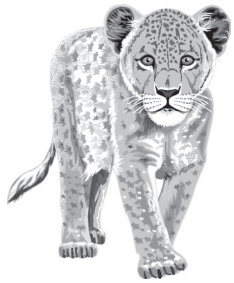
Name _____ *Date* _____

How Much Does it Cost?



The zoo purchases only the best-quality meats and vegetables for the animals. Each cub is fed top round steak that cost $2.29 per pound. Use this information and the information from page 94 to calculate the cost of feeding one of the cubs.

Age of Lion	Cost per Day	Cost per Week	Cost per Month (30-days)
3 months old			
6 months old			
1 year old			
Adult: 18 months old			

1. A litter of 3 lion cubs was born at the zoo. When these cubs reach adulthood, how much will their food cost each year if the zoo continues to feed them top round steak at the same cost? _____

2. What percent of increase is there between feeding a 3-month-old cub each day and an 18-month-old adult each day? Be sure to show how you solved this problem.

_____

_____

_____

3. The amount a lion eats depends on the time of year. Why do you think this is so? At what time of the year might they eat more? At what time of year might they eat less? Explain your answer. _____

_____

_____

_____

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Polar Bear Growth vs. Human Growth

Math Skills

- Reading data tables
- Calculating percent of increases greater than 100%
- Graphing
- Solving problems

Materials Needed

- "Comparing Polar Bear Growth to Human Growth" activity sheet (p. 98) for each child
- "The Graph" actvity sheet (p. 99) for each child
- Calculators
- Colored pencils (if available)

Background Information and Suggested Teaching Strategies

Many animals when born in the wild are extremely small at birth. Black bears weigh only $\frac{1}{2}$ lb or about 0.22 kg, and although the polar bear is the largest carnivorous land mammal, young polar bears are the most undeveloped of the land mammals. Newborn polar bear cubs are blind, have very little fur to keep them warm, and are totally helpless. Mother polar bears commonly weigh about 660 lbs (300 kg). It is not uncommon for the ratio of the weight of the mother to the baby to be 400 or 500 to 1! The table comparing the weights of polar bear cubs and human males shows how rapidly the bear grows. By the time it is $2\frac{1}{2}$ years old, it is on its own.

It is a good idea to go over the data table with students and review conversion within the metric system. The weight of the newborn cub is shown as 600 g. To make comparisons, students should convert this to 0.6 kg.

The weights of the human baby were obtained from the Center for Disease Control tables of weights for boys at the 50th percentile on http://www.cdc.gov/growthcharts. The polar bear's data was obtained on the Polar Bear International Web site: http://www.polarbearsinternational.org/polar-bears-in-depth/description/.

Remind students that although the ages on the data table do not represent equal units (0, $\frac{1}{2}$, 1, 5, and 13), the units on the graph must be equal. Allow students to problem solve appropriate units for their graphs. The answers shown here may not reflect the units chosen by students.

Communicating through Journaling

The black bear's birth weight is about $\frac{1}{2}$ lb, and at one year, he weighs about 50 lbs. The average male human baby's birth weight is about 8 lbs and at one year he weighs about 20 lbs. What is the percentage of increase for the bear cub? What is the percentage of increase for the human baby? Explain how you solved these problems.

Answer:

Percent of increase = $\frac{\text{amount of increase}}{\text{original amount}} \times 100$;

Black bear: $\frac{49.5}{.5} \times 100 = 9{,}900\%$ increase

Human: $\frac{12}{8} \times 100 = 150\%$ increase

Possible Extension Ideas

Have students collect data about the class: What did each weigh at birth and then at one year of age? What was the percent of increase for each student? Ask students to analyze data using mean, median, modes, and ranges.

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Activity Answers

Most answers have been rounded to the nearest whole number.

Comparing Polar Bear Growth to Human Growth

1. The human baby is about six times heavier at birth: $0.6x = 3.5 = 5.83$ or 6

2. a. 3567%; 108,233%

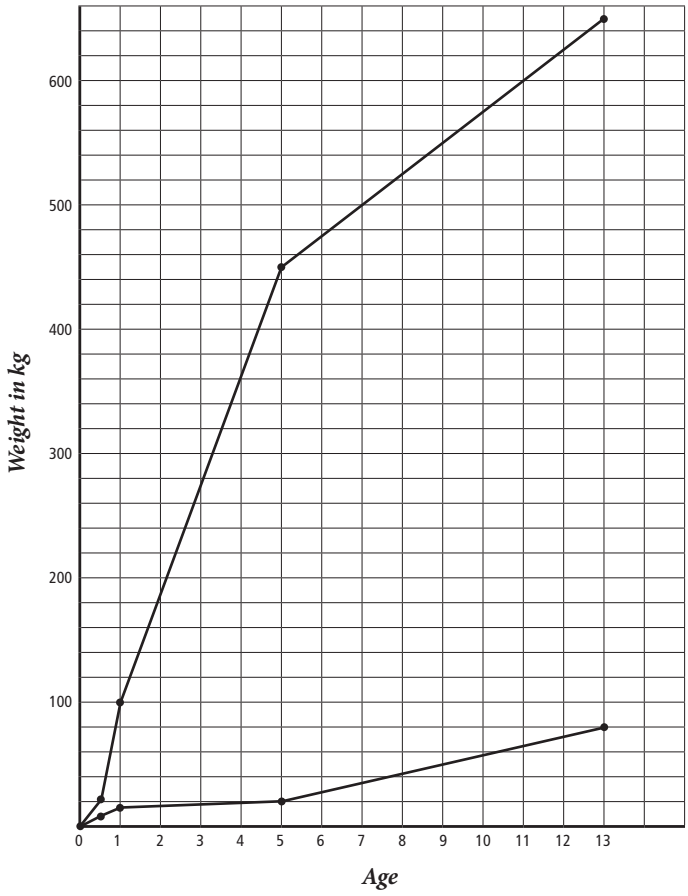
b. 100%; 2186%

c. Students may use different strategies, but the formula for finding the percent of increase is:

$$\text{Percent of increase} = \frac{\text{difference in weight}}{\text{original weight}} \times 100$$

3. Students may explain the growth patterns in a number of ways.

The Graph



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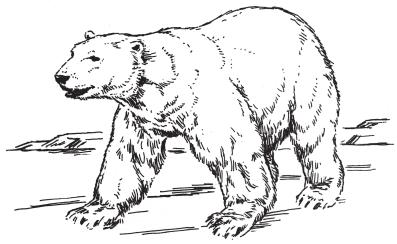
Name _____ *Date* _____

Comparing Polar Bear Growth to Human Growth



Polar bears are the largest land carnivores. Males grow to about three times the size of females. The largest recorded polar bear weighed more than 2,000 pounds (lbs)! It's amazing that at birth male polar bears are so tiny and human babies weigh so much more, but this changes very quickly!

The following table has information about the approximate weights of both polar bear cubs and human babies. Use the data in the table to help you solve the problems below. To convert from metric to customary measurements, use: 2.2 lbs = 1 kg.

Weights in Metric Units—grams (g) or kilograms (kg)					
Age	***Birth***	***6 month***	***1 year***	***5 years***	***13 years***
Polar bear	600 g	22 kg	100 kg	450 kg	650 kg
Male human	3.5 kg	7 kg	15 kg	20 kg	80 kg

1. About how many times heavier is the human baby than the polar bear cub at birth? (***Hint:*** To compare these weights, you must convert g to kg or kg to g.) _____

2. a. Calculate the percentage of increase in weight for the polar bear between birth and 6 months: _____ ; Between birth and 13 years: _____

b. Calculate the percentage of increase in weight for the human male baby between birth and 6 months: _____ ; Between birth and 13 years: _____

c. Explain how you solved these two problems. Be sure to show all of your work.

_____

_____

3. Examine the data on this chart and describe the growth patterns that the data reveal for both the polar bear and the male human.

_____

_____

_____

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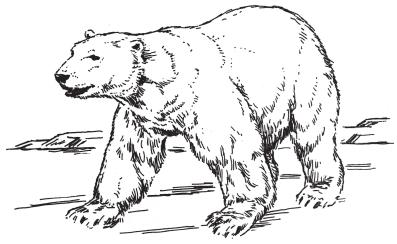
Name _____ *Date* _____

The Graph



Draw a graph to show the growth of both the polar bear and human male baby. Use different colors to show the weight gain of each. Be sure to title the graph, choose appropriate units for each axis (Remember: The units must be equal.), and supply a key.

Title _____

Weight in kg

Age

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The Leaping Gazelle

Math Skills

- Collecting data
- Working with statistics
- Drawing graphs, measuring
- Solving problems

Materials Needed

- "Group Data Collection Sheet" activity sheet (p. 102) for each group of four students
- 1 yardstick per group
- "Class Data Table" activity sheet (p. 103) for each student
- "Line Plot" activity sheet (p. 104) for each student
- Calculators
- Overhead transparencies of the Class Data Table and the Line Plot activity sheets

Background Information and Suggested Teaching Strategies

This is an open-ended data collection activity. Allow student groups of four time to discuss their strategies for measuring how many steps it would take each member to walk the 30 feet. They have only a yardstick for measuring. On the Group Data Collection Sheet, groups record a number of steps for each student in their group. They then determine a mean for their group's data.

After each group has collected their data, they calculate the group mean. They then record the mean on the Class Data Table. By doing this, they can predict the mean number of steps students their age need to walk 30 feet. Ask groups to discuss the conclusions that can be drawn from the class data. Give each group a chance to share their conclusions with the rest of the class.

The Line Plot activity sheet gives students an opportunity to share their individual data with the class. Up to this point, only the groups' means have been used. A line plot is used to give each student the opportunity to enter his or her own data on the graph. The units on the graph will depend on the range of data. Each step is delineated. Work through the steps with the class and enter the units on the graph. Each student can then enter the number of steps they took in the correct location on the graph.

Once all of the data is graphed, it can be used to find the:

1. range—Is this already known?
2. median—Can it be found without rewriting the data from least to greatest?
3. mode—Is there one mode, more than one, or none at all?
4. mean of the individual data—Is it the same as the class mean (which takes the mean of the mean)?

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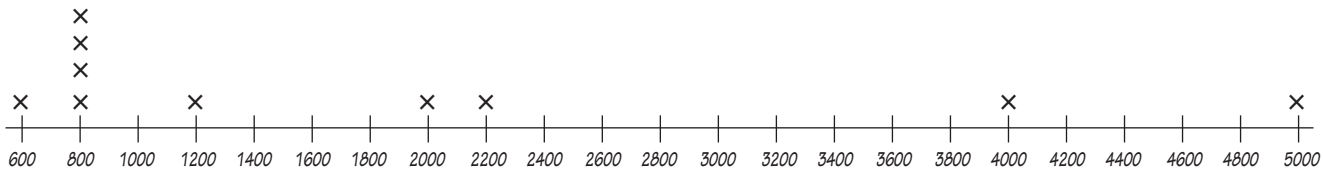
Communicating through Journaling

Use this data to draw a line plot. Then find the range, median, and mode of the data.

Animal	*Weight in kg*
African elephant	5,000
Indian elephant	4,000
white rhinoceros	2,200
hippopotamus	2,000
giraffe	1,200
bison	800
Kodiak bear	800
yak	800
Alaskan moose	800
polar bear	600

Answer:



The range is 4,400 kg; the median is 1,000 kg; the mode is 800 kg.

Possible Extension Ideas

Have students survey and collect data to obtain the mean weight of students their age in kilograms. How many students would it take to equal the weight of one African elephant?

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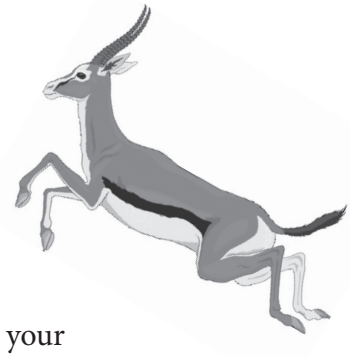
Group Data Collection Sheet



Do you know the way a gazelle protects itself from dangerous predators? It's amazing! The gazelle can jump 10 feet into the air and leaps 30 feet in a single bound! Let's try to understand just how remarkable this is.

How high is your classroom? Do you think if the gazelle jumped in your classroom, he or she would hit the ceiling? Explain your group's answer:

_____

_____

_____

Directions: Now let's see how many steps it takes a human to travel the 30 feet a gazelle can travel in one jump.

1. First, measure out a distance of 30 feet.
2. Then decide on a strategy to use for measuring the number of steps each group member must make to travel 30 feet. You have only a yardstick.
3. Now take turns within your group. One will travel the 30 feet while another group member counts the number of steps.
4. On the table below, record the number of steps for each group member.
5. As a group, determine the mean for your group's data and record it below.

Name of person	*Number of steps needed to walk 30 feet*
Group Mean	

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Name _____ *Date* _____

Class Data Table

Directions: Record each group's mean on the following table. Then as a group, determine the mean for the class's data and record it below.

Group	*Mean number of steps needed to walk 30 feet*
Class Mean	

By analyzing the data from this experiment, what conclusions can you draw? Discuss this question with your group and be prepared to discuss it with the class.

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Name _____ *Date* _____

Line Plot

Each group will report each piece of data and we will use it to make an interesting graph called a "line plot." This graph will give us a way to analyze each individual's data. But first we must problem-solve the units between coordinates on the graph and label each coordinate.

Directions:

1. Determine the range of the class data.
2. Find the number of graphing units on the line plot.
3. Use the range to calculate the size of each unit.
4. Label the coordinates on the graph.
5. Place an X above one of the coordinates to represent one child in the class.

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The Logic in Animal Species

Math Skills

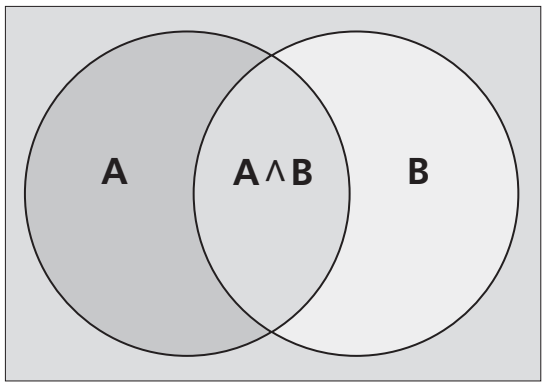
- Using mathematical logic and Venn diagrams

Materials Needed

- A set of animal cards (pp. 109–112) for each pair of students
- Venn diagrams 1 and 2 activity sheets (pp. 107 and 108) for each pair of students

Background Information and Suggested Teaching Strategies

A Venn diagram is a drawing in which intersecting circles are used to represent things sharing common properties. It is part of set theory, but the idea of visually representing logical relationships was developed by John Venn (1834–1923). Although the symbols used in Venn diagrams are not part of this lesson, this diagram shows the intersection (∧) of sets A and B:



There are 24 animal information cards included in this lesson. You can make others using some of the zoo Web sites listed at the end of the chapter. Based on the information given, students will classify each animal as a carnivore, herbivore, or both (omnivore). Then students write each animal's name in one of the three sections of the diagram. Those animals that appear in the center section are omnivores.

When students have finished the first diagram, have them use the information on the cards to develop a Venn diagram using different categories. Allow time for students to share their classifications.

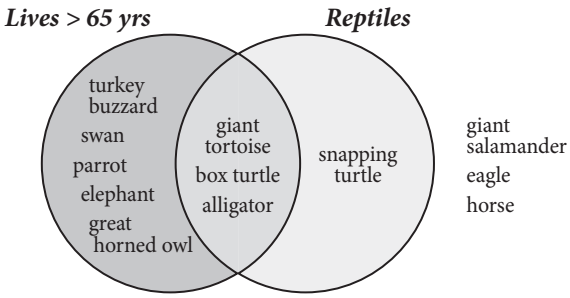
Communicating through Journaling

Complete a Venn diagram using data on life expectancies for animals. Make one circle for reptiles and one for animals that live longer than 65 years. Use the data about how long some animals live to complete a Venn diagram.

Animal	*Type*	*# of Years*
giant tortoise	reptile	152
box turtle	reptile	123
turkey buzzard	bird	118
swan	bird	102
parrot	bird	80
elephant	mammal	69
great horned owl	bird	68
alligator	reptile	68
snapping turtle	reptile	57
giant salamander	amphibian	55
eagle	bird	55
horse	mammal	50

Source: Data from http://www.newton.dep.anl.gov/natbltn/400-499/nb486.htm.

Answer:



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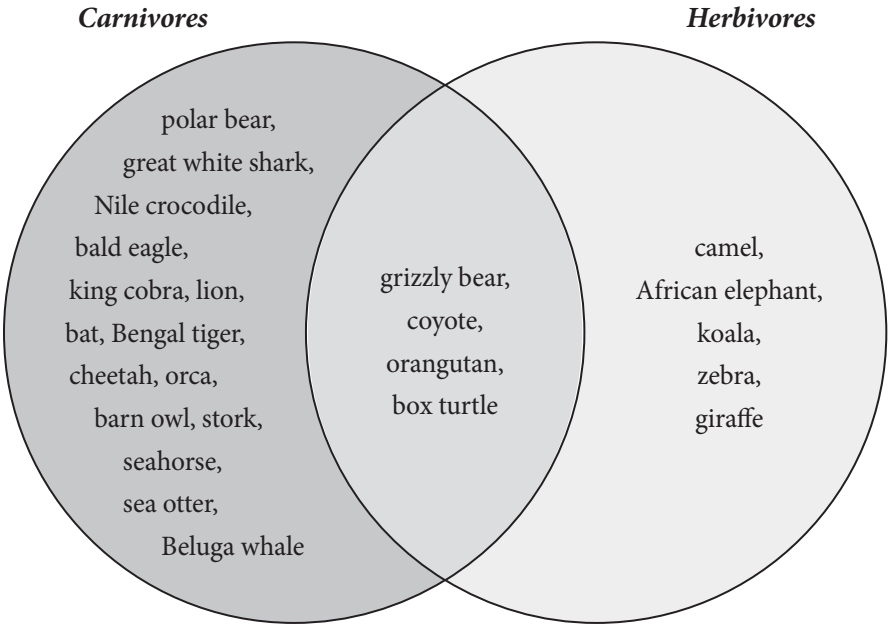
Possible Extension Ideas

The Web site at http://faculty.washington.edu/chudler/chasleep.html titled "How Long do Animals Sleep?" lists more than 30 animals that sleep from 19.9 hours (the brown bat) to the giraffe that sleeps for only 1.9 hours a day. Ask students to use the information on this data table to design a Venn diagram and be prepared to share it with the class.

Activity Answers



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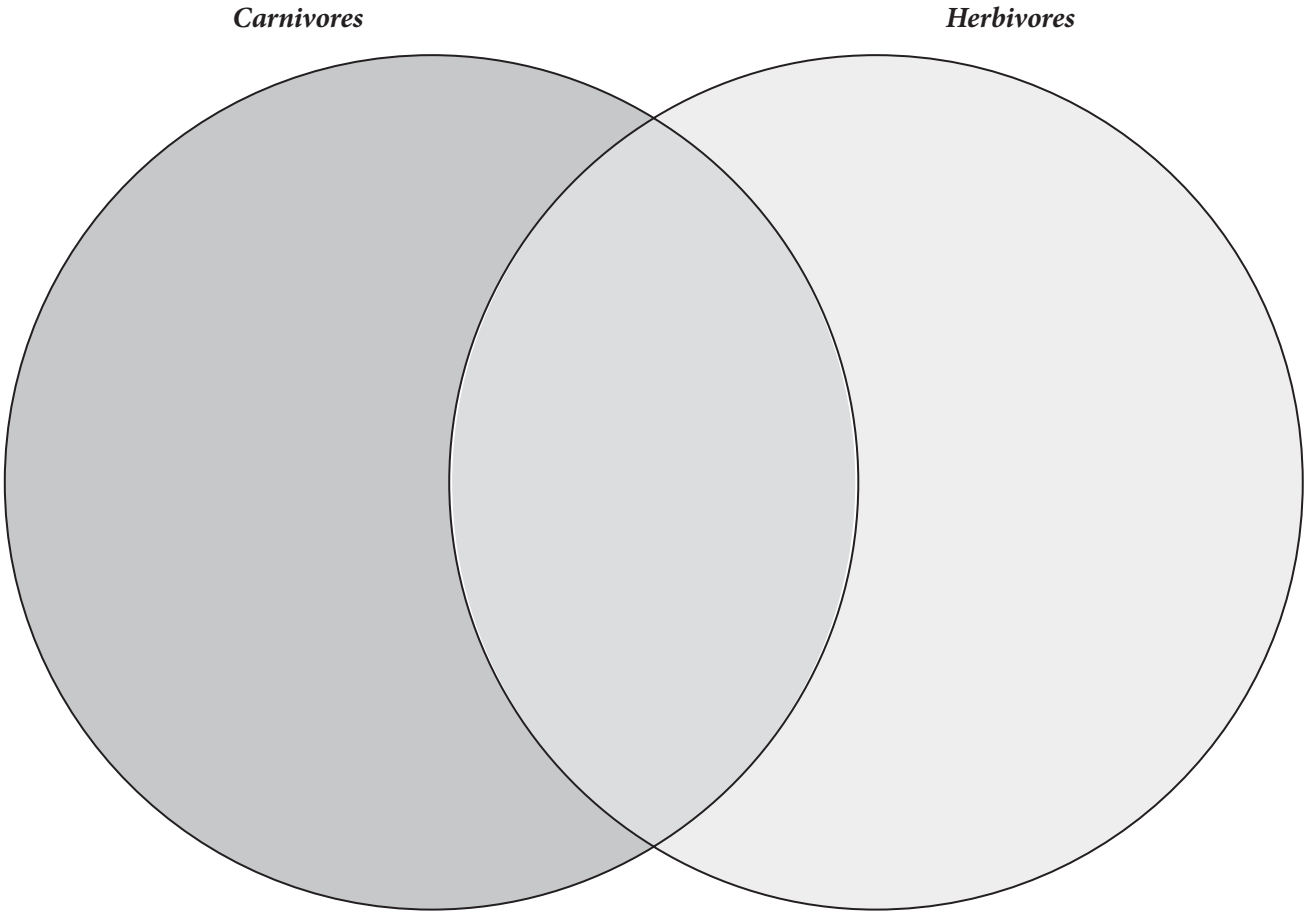
Name _____ *Date* _____

Animal Venn Diagram 1

Directions: Use the set of animal cards to find animals that belong in each section below. Write each in the correct part of the diagram. You will need to think about what animals might belong in the intersection of the two circles.



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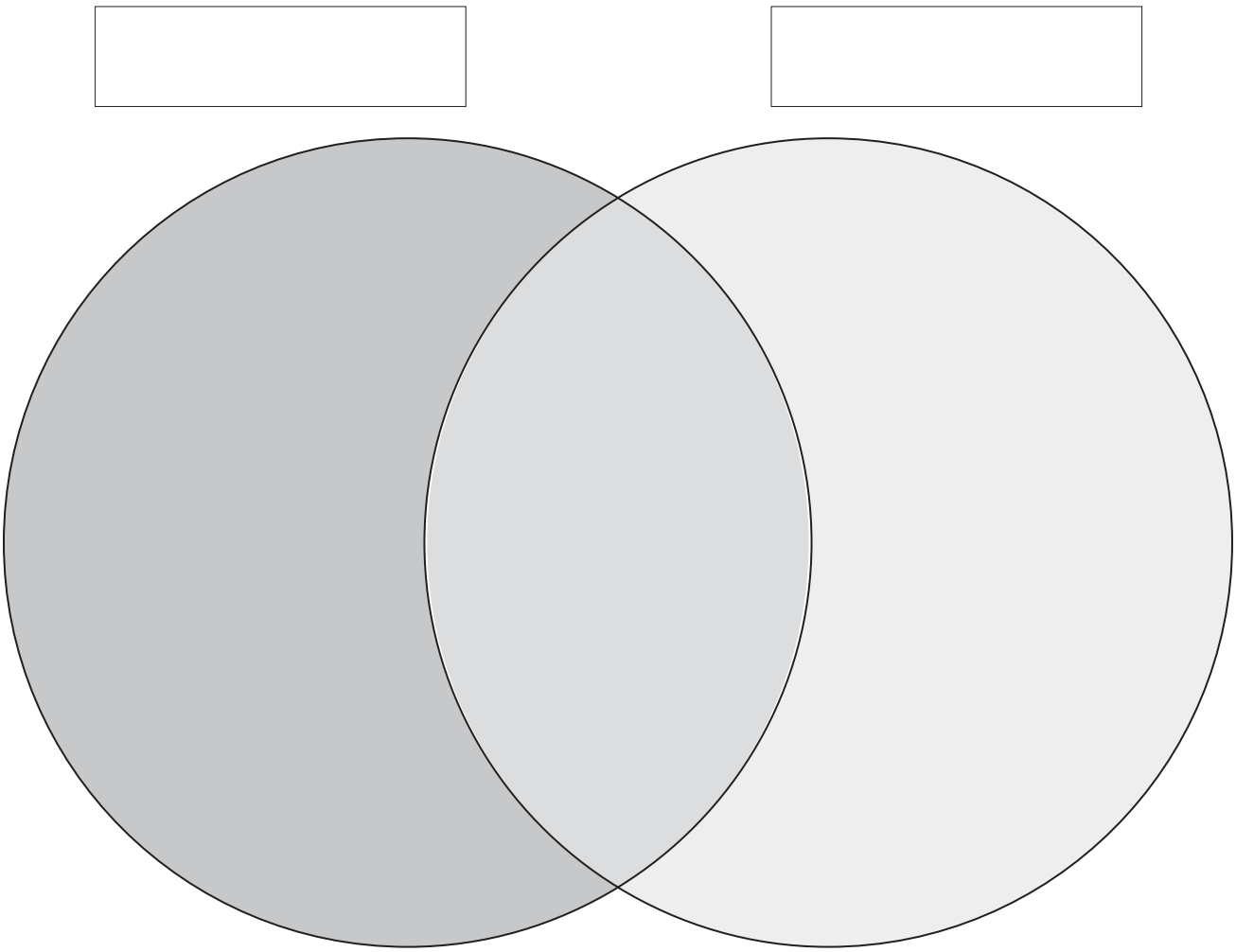
Name _____ *Date* _____

Animal Venn Diagram 2

Directions: Work with your group to design your own Venn diagram problem. Use the set of animal cards to help you label each of the circles, and solve your own puzzle.



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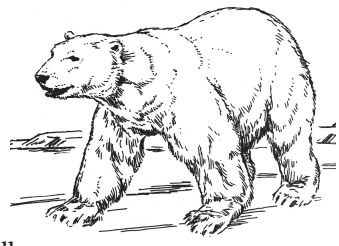
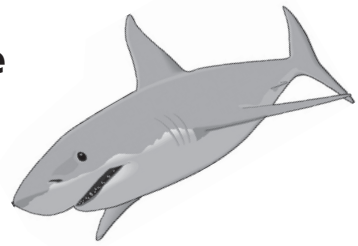
Polar Bear



Mammals

Weight: about 1,500 lbs
Length: 8–10 feet
Number of Young: usually 2
Gestation Period: average: $7\frac{2}{3}$ months
Classification: carnivore
Life Span: Usually 15–18 years; up to 30 years

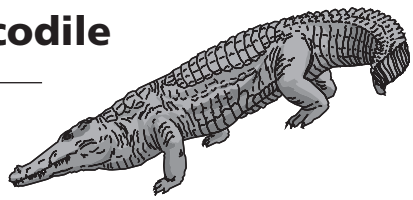
Great White Shark



Fish

Weight: about 6,500 lbs
Length: 12–20 feet
Number of Young: usually 1–2
Gestation Period: about 12 months
Classification: carnivore
Life Span: 30–50 years

Nile Crocodile



Reptiles & Amphibians

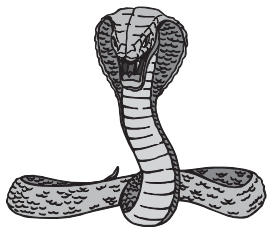
Weight: about 2,000 lbs
Length: up to 20 feet
Number of Eggs: 25–100
Gestation Period: 95–100 days
Classification: carnivore
Life Span: 70–100 years

Bald Eagle

Birds

Weight: about 12 lbs
Length: 30–36 feet
Number of Young: usually 2
Incubation Period: about 35 days
Classification: carnivore
Life Span: about 25 years

King Cobra



Reptiles & Amphibians

Weight: 12–18 lbs
Length: average 13 feet; up to 16 feet
Number of Eggs: usually 40
Incubation Period: 70–77 days
Classification: carnivore
Life Span: about 20 years

Grizzly Bear

Mammals

Weight: 500–700 lbs
Length: 5–8 feet
Number of Young: usually 2
Gestation Period: about $7\frac{1}{2}$ months
Classification: omnivore
Life Span: up to 25 years

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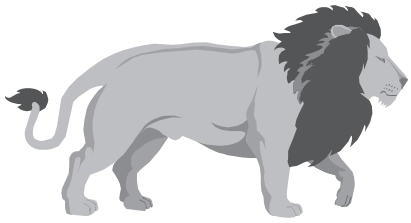
Lion

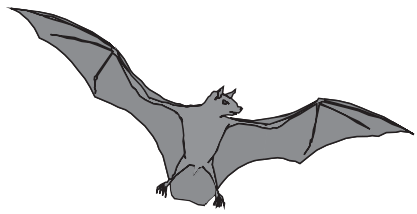
Mammals



Weight: 330–350 lbs
Length (with tail): 36–41 feet
Number of Young: 1–4
Gestation Period: 102–113 days
Classification: carnivore
Life Span: up to 16 years

Bat

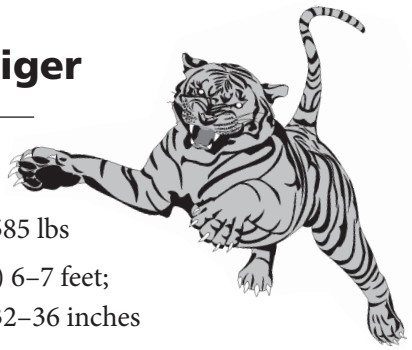
Mammals



Weight: $\frac{1}{2}$ to $1\frac{3}{4}$ oz
Length: about 3 inches
Number of Young: 1
Gestation Period: 205–214 days
Classification: carnivore
Life Span: up to 16 years

Bengal Tiger

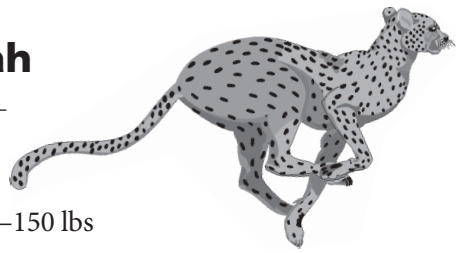
Mammals



Weight: 400–585 lbs
Length: (body) 6–7 feet;
(tail) 32–36 inches
Number of Young: 2–4
Gestation Period: 92–112 days
Classification: carnivore
Life Span: up to 26 years

Cheetah

Mammals



Weight: 75–150 lbs
Length: (body) 4–5 feet;
(tail) 2–2.5 feet
Number of Young: usually 2–5
Gestation Period: 90–95 days
Classification: carnivore
Life Span: about 12 years

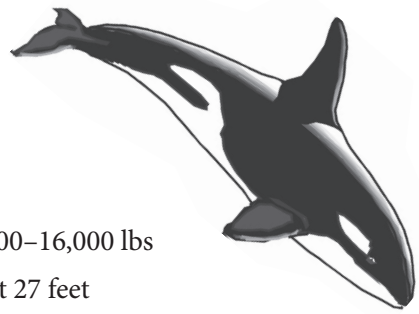
Coyote

Mammals

Weight: 20–40 lbs
Length: (body) 30–40 inches;
(tail) 12–16 in
Number of Young: usually 6
Gestation Period: 58–65 days
Classification: omnivore
Life Span: about 15 years

Orca

Mammals



Weight: 12,000–16,000 lbs
Length: about 27 feet
Number of Young: 1
Gestation Period: 15–17 months
Classification: carnivore
Life Span: about 30 years

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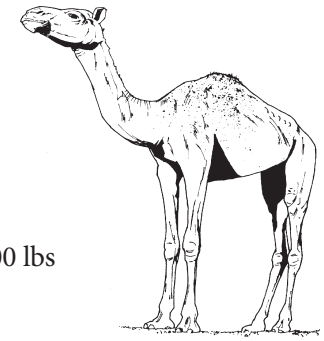
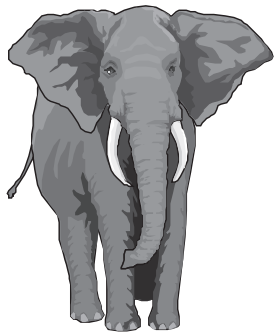
Camel



Mammals

Weight: about 1,500 lbs
Length: 10 feet
Number of Young: usually 1
Gestation Period: 12–15 months
Classification: herbivore
Life Span: 40 years

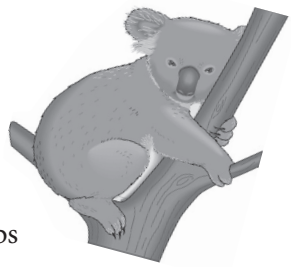
African Elephant



Mammals

Weight: up to 17,000 lbs
Length: 20–24 feet
Number of Young: 1
Gestation Period: about 22 months
Classification: herbivore
Life Span: 15–30 years

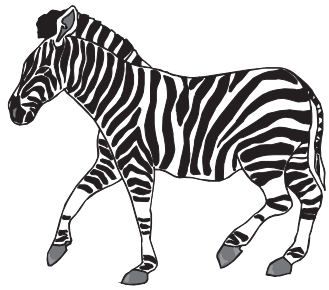
Koala



Mammals

Weight: about 10–30 lbs
Length: 2–3 feet
Number of Young: 1
Gestation Period: about 35 days
Classification: herbivore
Life Span: 12+ years

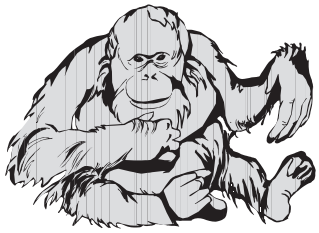
Zebra



Mammals

Weight: about 600–800 lbs
Length: 6–9 feet
Number of Young: 1
Gestation Period: about 12 months
Classification: herbivore
Life Span: about 20 years

Orangutan



Mammals

Weight: 110–200 lbs
Length: 3–4 $\frac{1}{2}$ feet; males are larger
Number of Young: usually 1
Gestation Period: 9 months
Classification: omnivore
Life Span: 35 years

Giraffe

Mammals

Weight: 1,300–3,300 lbs; males are larger
Length: 16–19 feet tall
Number of Young: usually 1
Gestation Period: 14–15 months
Classification: herbivore
Life Span: up to 25 years

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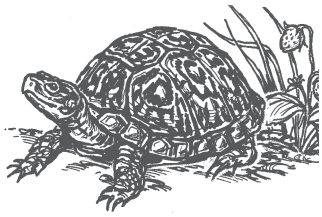
Box Turtle



Reptiles

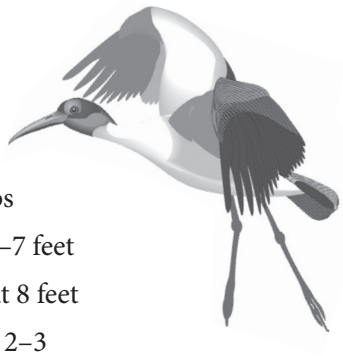
Weight: 1–2 lbs
Length (with tail): 4–55 inches
Number of Eggs: 2–7
Incubation Period: 3 months
Classification: omnivore
Life Span: 25+ years

Barn Owl

Birds

Weight: 1 lb
Length: 17–18 inches
Wing Span: 43 inches
Number of Eggs: 4–7
Incubation Period: 10–12 weeks
Classification: carnivore
Life Span: 5–11 years

Stork



Birds

Weight: 10–20 lbs
Length (body): 6–7 feet
Wing Span: about 8 feet
Number of Eggs: 2–3
Incubation Period: 30 days
Classification: carnivore
Life Span: about 20 years in captivity

Seahorse

Fish

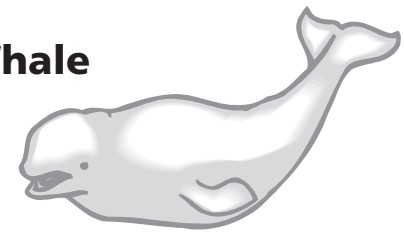
Weight: a few ounces
Length: 7 inches
Number of Eggs: large numbers
Incubation Period: 10–60 days
(depending on species)
Classification: carnivore
Life Span: unknown, but thought to be 1–4 years

Sea Otter

Mammals

Weight: 70–85 lbs
Length (body): about 60 inches
Number of Young: usually 1
Gestation Period: 4–6 months
Classification: carnivore
Life Span: 10–15 years

Beluga Whale



Mammals

Weight: 1,400–3,000 lbs
Length: 13–16 feet
Number of Young: 1
Gestation Period: 16–17 months
Classification: carnivore
Life Span: about 30 years

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The Remarkable Leaping Frog

Math Skills

- Collecting and analyzing data
- Measuring
- Solving statistical problems

Materials Needed

- "Did You Know . . ." fact sheet (p. 114) for each group of four
- "Group Data Collection Table" activity sheet (p. 115) for each group of four
- "Class Data Table" activity sheet (p. 116) for each student
- Meter sticks, yardsticks, or tape measures
- Masking tape to mark off starting and ending points
- Calculators
- Overhead transparency of Class Data Table

Background Information and Suggested Teaching Strategies

This is an open-ended problem-solving activity in which students work in groups of four to collect data on the average or mean length of their jumps. The lesson begins with the "Did You Know . . ." facts. Two of the facts are the basis of this lesson—the first is that frogs can leap up to twenty times their body length and the second is that a champion frog, Santjie, leaped 33 ft 5.5 in.

Go over these remarkable facts with students. Then review the directions, give them the supplies they need, and then let them "go at it!" The results of this activity will depend on the age of the students and their athletic abilities. For that reason, there are no correct answers. After each group has collected its data, enter the results on the Class Data Table and give students the opportunity to discuss the results and analyze the data.

Communicating through Journaling

Explain the procedures your group used to measure the distances each member leaped, and analyze and compare your data to the abilities of the master frog-jumpers.

Possible Extension Ideas

If You Hopped Like a Frog by David M. Schwartz discusses the remarkable achievements of frogs, ants, snakes, shrews, fleas, and many more. The interesting thing about the way Schwartz writes is that he tells the reader that, "If you ate like a shrew . . . you could devour 700 hamburgers a day." Then, in the back of the book, he explains (mathematically) how he arrived at his conclusions. You can adapt many of the amazing animal facts in his book to additional data collection lessons for students.

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Did You Know ...

- ☞ That a frog can leap up to twenty times its body length?
- ☞ Like all amphibians, frogs are cold-blooded, meaning that their body temperatures change with the temperature of their surroundings?
- ☞ Wood frogs can live north of the Arctic Circle, surviving for weeks in a frozen limbo state? This frog uses glucose in its blood as a kind of antifreeze that concentrates in its vital organs, protecting it from damage while the rest of the body freezes solid.
- ☞ At a frog derby held in South Africa, a frog named Santjie made the longest frog leap on record? Santjie bested the competition with a leap of 33 ft 5.5 in.

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Name _____ *Date* _____

Group Data Collection Table

If we leap, how would our leap compare to that of the remarkable leaping frog Santjie? Let's conduct an experiment to find the answer to this question.

Directions: Work with your group to measure your height and the average length of a leap:

1. First measure each group member's height to the nearest inch. Record your measurements in the table below.
2. Have each person leap three times. Record the three measurements.
3. Determine the mean of the three trials and record it in the appropriate column on the table.
4. Find the mean height and leap of your group and place it on the table. We'll use this information in the next table.

Name	*Height*	*Trial 1*	*Trial 2*	*Trial 3*	*Mean*
Group Mean					

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Name _____ *Date* _____

Class Data Table

How did your leaps compare to the frog's leap? Remember that a frog can jump twenty times its length. Using your group means, how many times your height (or length) did your group jump?

Directions: Record each group's mean height and leap in the table below. Then determine how many times each group's decimal ratio mean height was each group's mean leap. Last, determine class means for height and leap.

Group	*Group's Mean Height*	*Group's Mean Leap*	*How Many Times the Group's Decimal Ratio Mean for Height and Leap?*
Class Mean			

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Feeding Gorillas at the Zoo

Math Skills

- Converting between measurement systems
- Reading tables
- Graphing
- Solving problems related to percents

Materials Needed

- "Feeding Gorillas at the Zoo" activity sheet (p. 119) for each student
- "The Pie Graph" activity sheet (p. 120) for each student
- Protractors
- Rulers
- Colored pencils or markers
- Calculators
- Overhead transparency of "Feeding Gorillas at the Zoo" activity sheet

Background Information and Suggested Teaching Strategies

The great apes, including gorillas, are considered an endangered species in the wild. The principal cause of the decline in their population is habitat destruction, particularly due to commercial logging. Troops of lowland gorillas are found in Cameroon, Central African Republic, Gabon, Congo, and Equatorial Guinea. The herbs, shrubs, and vines that make up the majority of the gorillas' diet grow best where there is an opening in the canopy and light can reach the forest floor.

The zoo diet of the gorillas is described on the student activity sheet along with the weight of the foods (in kilograms) and the cost of the foods (in pounds). Before students can calculate the costs, ask them to convert the amount of kilograms purchased to pounds. There are approximately 0.45 kg per lb. Rather than use formulas, students might feel more comfortable setting up the problem as a ratio. For example, the ratio students can use to calculate the number of pounds of miscellaneous foods is

$$\frac{0.45 \text{ kg}}{1 \text{ lb}} = \frac{3.4 \text{ kg}}{x \text{ lb}}$$

or about 7.6 lbs. Give students the opportunity to set up their own ratios.

Communicating through Journaling

There was a frost in California and the cost of leafy greens went from 89¢ per lb to $1.39 per lb. If the zoo still purchases 38.4 kg (remember 1 kg ≈ 0.45 lb), how much more will the greens cost this week?

Answer: Students may use a variety of strategies to solve this problem. This is one possible way: First convert 38.4 kg to lbs (38.4 ÷ 0.45 = 85.3 lbs). Since the increase in price is 50¢ per pound, then 85.3 lbs × 0.50 = $42.65 is the increase in cost.

Possible Extension Ideas

Contact a local zoo and ask to speak to a zookeeper. See if he or she can give you local data for students to work with.

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Activity Answers

Feeding Gorillas at the Zoo

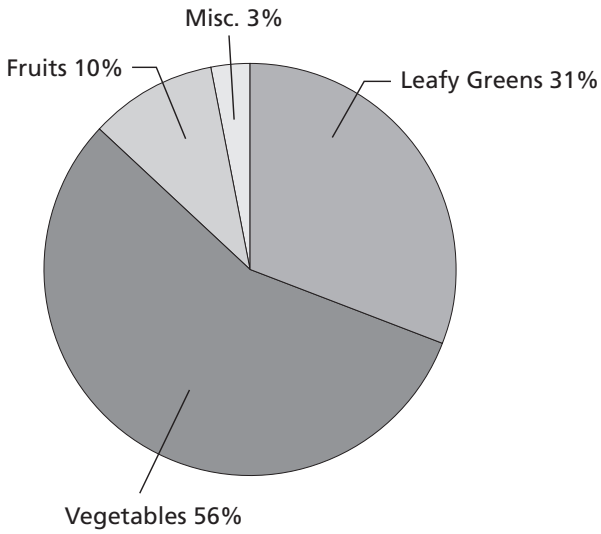
1. The answers to the questions on the table are shown in bold. All weights have been rounded to the nearest tenth and the costs to the nearest cent.

Category	*Cost per lb*	*Weight in kg*	*Weight in lbs*	*Cost for this category*
leafy greens	$0.89	38.4	**85.3**	**$75.92**
vegetables	1.29	69.3	**154.0**	**198.66**
fruits	2.19	12.9	**28.7**	**62.85**
miscellaneous	2.49	3.4	**7.6**	**18.92**
Total		124.0	**275.6**	**$356.35**

2. Leafy greens 31%, Vegetables 56%, Fruits 10%, Miscellaneous 3%. All answers have been rounded to the nearest whole percent.

The Pie Graph

If the percent of each category has been correctly calculated, the graph will look like this:



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Name _____ *Date* _____

Feeding Gorillas at the Zoo

The Western Lowland Gorilla is the largest of the living primates. Its diet in the wild consists of leaves, stems, and insects. In captivity, zoos need to feed gorillas a diet that will keep them healthy on foods that are readily available. Lincoln Park Zoo in Chicago, Illinois, has divided gorillas' diet into four categories: The first is "leafy greens." Some of the foods in this category are lettuces, endive, kale, and spinach. The second category is "vegetables." Most of the vegetables from A to Z are in this category—from acorn squash to zucchini. The third category, "fruits," contains many items, from apples to watermelon. The fourth category, miscellaneous, contains carbohydrates, such as cereals and grains, and cheeses for protein. The zoo purchases all of the items in kilogram (kg) weights, but the store price is always shown as amount per pound (amount/lb). This table lists the cost per pound and the total kilograms purchased of each category during one particular week:

Category	*Cost per lb*	*Weight in kg*	*Weight in lbs*	*Cost for this category*
leafy greens	$0.89	38.4		
vegetables	1.29	69.3		
fruits	2.19	12.9		
miscellaneous	2.49	3.4		
Total		124.0		

Directions: Use the information in the table to answer the following questions.

1. Complete the table by converting the kilograms (kg) to pounds (lbs) and calculating the cost for each of the categories. Then find the total cost for this one week.
Hint: 1 lb ≈ 0.45 kg. Show your work here:

2. Each category is what percentage of the total amount of food? Show your work below.

Leafy greens: _____ Vegetables: _____ Fruits: _____ Miscellaneous: _____

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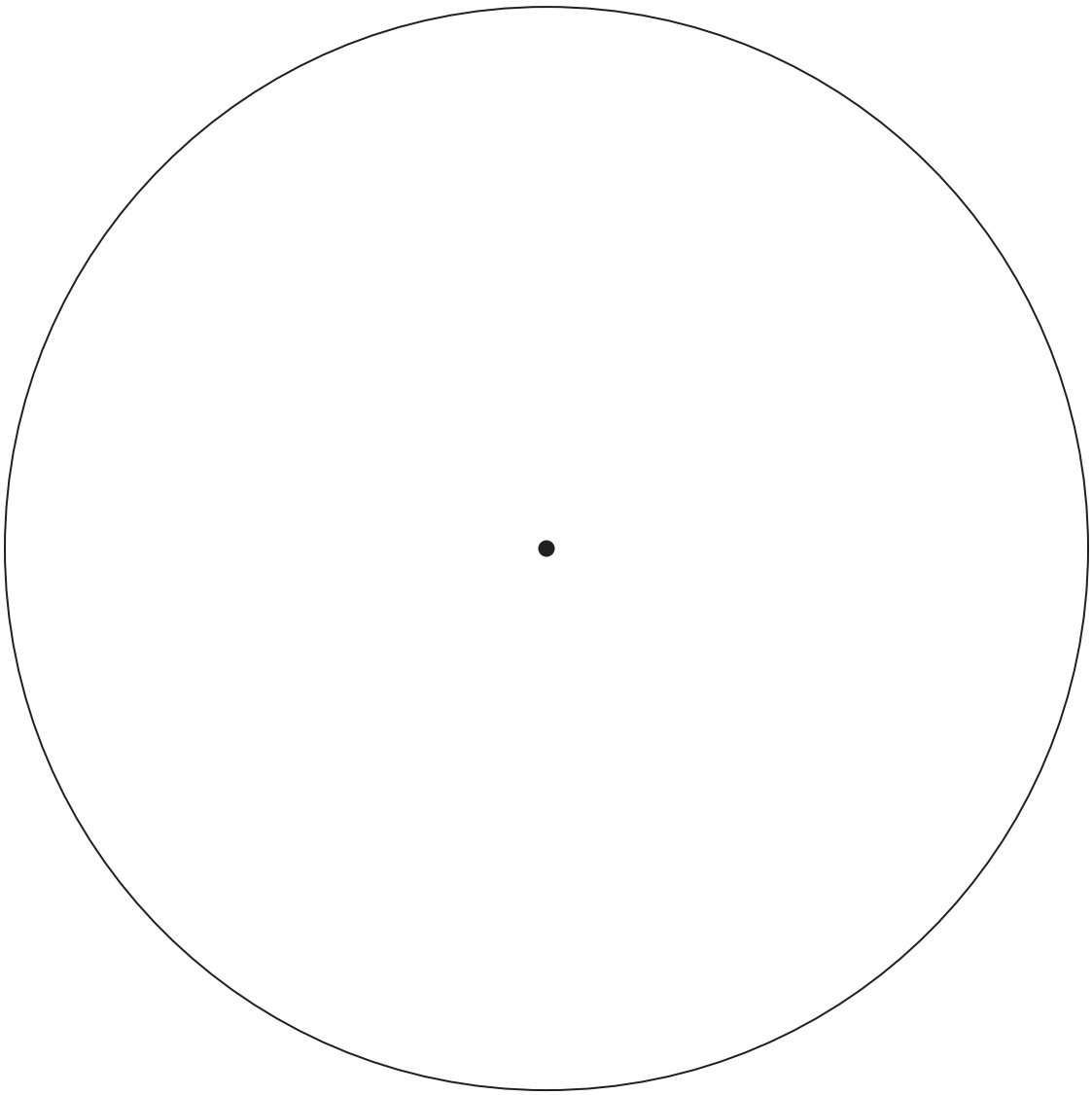
Name _____ *Date* _____

The Pie Graph

Directions: Use the percentages on the previous page to help you design a pie graph to illustrate the categories of food fed to the gorillas. Be sure to title the graph and label each section.

Title _____



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Animal Enclosures

Math Skills

- Estimating volume
- Finding area and volume
- Using computation to solve problems

Materials Needed

- "Animal Enclosures" activity sheet (p. 122) for each student
- Overhead transparency of "Animal Enclosures" activity sheet
- Calculators

Background Information and Suggested Teaching Strategies

A zoo wants to build an enclosure that "gives the animals the most room to move around." This activity asks students to compare a cylinder with a rectangular prism to determine which of the two has the greater volume. One of these will be an enclosure used for animals that move around in both trees and on the ground. Discuss with students how they will determine which of the enclosures pictured below, if either, will serve the animals better.

Mathematically, the students will need to calculate the volume of each of the enclosures. The formula for finding the volume of a cylinder is: $V = Bh$, where B is the area of the base and h is the height of the cylinder. The formula for finding the volume of a rectangular prism is $V = lwh$, where l is the length, w is the width, and h is the height. Review these formulas with students and ask how to find the area of the circular base. Tell them to use 3.14 for π.

Communicating through Journaling

A can of orange drink is 5 inches tall with a diameter of $2\frac{1}{2}$ inches. Which is greater, its circumference or its height? (Remember: $C = \pi d$ and $\pi = 3.14$.)

Answer: $C = 3.14 \times 2.5$; $C = 7.85$ inches. It's circumference is larger than its height.

Possible Extension Ideas

The volume of various real-world objects (such as product cans and cereal boxes) can be calculated to review finding the volume of polyhedra.

Activity Answers

The volume of the cylinder:

$V = (3.14 \times 10^2) \times 30 = 9{,}420 \text{ ft}^3$

The volume of the prism:

$V = 30 \times 20 \times 10 = 6{,}000 \text{ ft}^3$

Because the cylinder is $3{,}420 \text{ ft}^3$ larger than the prism, it will probably give the animals more room to move around.

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Name _____ *Date* _____

Animal Enclosures

A zoo is considering two different enclosures for animals that are as much at home in the air as on the ground. In other words, they will move around up in trees, as well as on the ground.

Directions: Make an estimate by circling which of these statements is true. Of the two enclosures shown:

a. The enclosures are the same size. b. The cylinder is larger. c. The prism is larger.

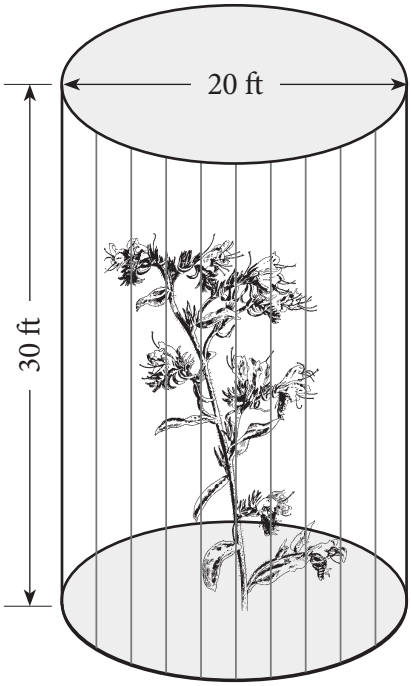
Briefly explain your reasoning. _____

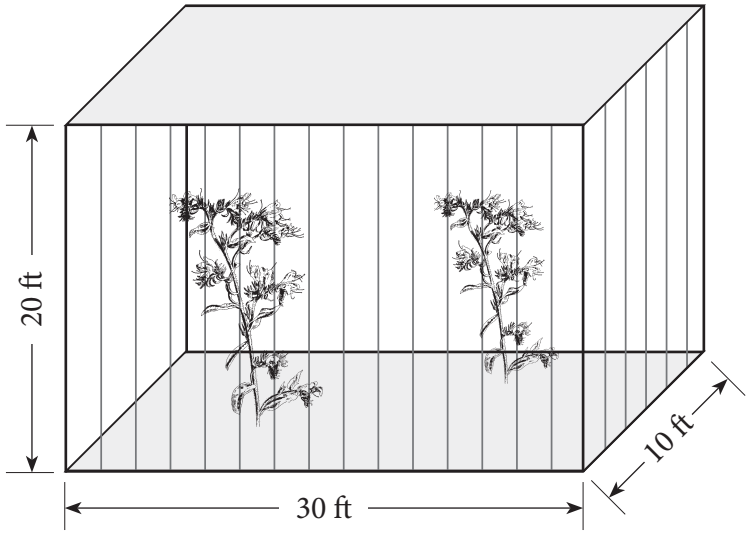
_____

_____

Now use your math skills to help you figure out which of these two enclosures, if either, would give the animals the most room to move around.

Answer: _____





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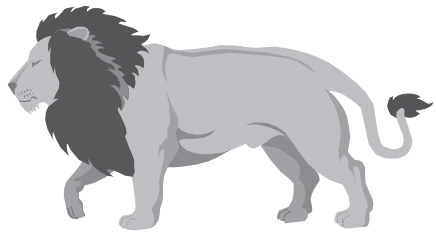
Name _____ *Date* _____

Zoo Math Puzzle



How do you take a lion's temperature?

Solve each problem. Then look for the answer at the bottom of the page. Place the letter of the problem above the correct answer to learn the answer to this joke.

U	**V**	**Y**	**A**	**C**
It costs $19.47 to feed a 1-year-old lion for 1 day. How much does it cost to feed him for 1 year?	A polar bear cub weighs 0.6 kg at birth and 650 kg at age 13. What percent of increase is this?	Giant tortoises live ≈150 yrs. Brown bears live about 25 years. About how many times longer does the giant tortoise live than the brown bear?	There are about 2,700 species of snakes. Of these, 375 are venomous. What percentage of snakes are venomous?	A killer whale weighs about 181 kg at birth. Convert his birth weight to lbs. (***Hint***: 1 lb ≈ .45 kg)
F	**R**	**L**	**E**	
There are 17 species of penguins. The largest penguin weighs about 80 lbs. The smallest weighs $\frac{1}{50}$ the number of lbs. How much does the smallest penguin weigh?	Asian elephants eat about 330 lbs of food each day. Suppose a zoo pays about $1.65 per lb for its food. How much would it cost the zoo each week to feed this elephant?	Female zebras give birth to their first foal when they are about 6 years old. They have about 1 foal every 2 years until they are about 24 years old. About how many foals can a zebra give birth to?	Hummingbirds have a heart rate of about 1,260 beats per minute. About how many times does a hummingbird's heart beat per second?	

108,233%	**21**	**$3811.50**	**≈ 6**		**402 lb**	**≈ 14%**	**$3811.50**	**21**	**1.6 lb**	**$7106.55**	**≈ 9**	**≈ 9**	**≈ 6**

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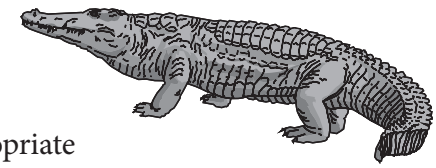
Name _____ *Date* _____

Animal Scramble

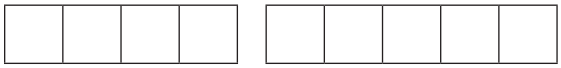


Directions: Unscramble each of these animal names. Then place the letters in the numbered boxes in the appropriate spot at the bottom of the page to receive a secret message.

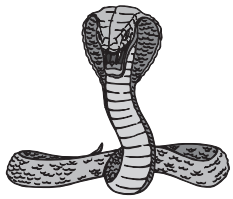
A O P L R R A E B

L D O R C C O I E

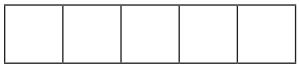
K G I N O A C B R



E G A L E



K H S A R



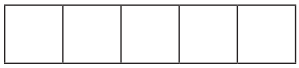
A B Z R E

C T E O Y O

G R I E T

K D C U

A W E L H



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Puzzle Answers

Zoo Math Puzzle

U $7106.55

V 108,233%

Y ≈ 6

A ≈ 14%

C 402 lb

F 1.6 lb

R $3811.50

L ≈ 9

E 21

VERY CAREFULLY

Animal Scramble

POLAR BEAR

CROCODILE

KING COBRA

EAGLE

SHARK

ZEBRA

COYOTE

TIGER

DUCK

WHALE

A DAY AT THE ZOO

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Math at the Zoo:

Books and Web Sites

Books

- Altman, J. *Lunch at the Zoo*. New York: Henry Holt & Company, 2001.
  A zoo's kitchen is a fascinating place that takes care of many different species of animals. This book includes a chart that shows the nutrients needed by each animal, what a typical meal is for a variety of animals, and whether they eat three meals a day or one meal every two weeks. Altman describes the lengths to which zoo personnel must go to care for the animals.

- Betancourt, J. *Ten True Animal Rescues*. New York: Scholastic, 1998.
  A gorilla takes care of a child who falls into her cage until he can be rescued, a cat saves an infant's life, a dolphin saves a drowning woman. These are just a few of the amazing true stories on how animals rescued humans.

- Farmer, N. *Warm Place*. New York: Penguin Young Readers Group, 1996.
  The author, who spent 17 years in Africa, learned much of the local folklore and has a wonderful talent for telling a story. Ruva, a young giraffe, is captured and sent to a zoo in San Francisco. With the help of two rats, a chameleon, and a runaway boy, she appeals to all the magical powers of the animal world to return to the "warm place" that is her home.

- Feiffer, J. *Room with a Zoo*. New York: Hyperion Books for Children, 2005.
  Julie says, "I have a zoo in my room. I need it. Because I'm either going to be a vet when I grow up or a zookeeper." And thereby hangs this tale!

- Ricciuti, E. R. *A Pelican Swallowed My Head and Other Zoo Stories*. New York: Simon & Schuster Children's Publishing, 2002.
  Go behind the scenes at the Bronx Zoo in New York. Workers tell fascinating tales about the animals they work with, from the recapture of an escaped python to the handler who got his head stuck in a pelican's pouch.

- Schwartz, D. M. *If You Hopped Like a Frog*. New York: Scholastic, 1999.
  A most interesting book that highlights amazing and unusual animal attributes and then explains the mathematics behind each.

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Books and Web Sites (continued)

- Wells, R. *What's Bigger Than a Blue Whale?* Morton Grove, IL: Albert Whitman, 1993.
  The blue whale is the largest creature on Earth, so is there anything larger? In this book, Wells takes us into space and examines these vast distances.
- Wells, R. *What's Smaller Than a Pygmy Shrew?* Morton Grove, IL: Albert Whitman, 1995.
  Is the pygmy shrew the smallest thing there is? She's only 3 inches tall! Wells moves to smaller animals, to microscopic organisms, and finally to molecules and atoms.
- Wells, R. *What's Faster Than a Speeding Cheetah?* Morton Grove, IL: Albert Whitman, 1997.
  Wells starts out by describing the speed of children, then land animals, and then birds. He goes on to describe the speeds of airplanes, rockets, sound, and then light.

Web Sites

- www.zoos.org

  This most comprehensive site on the Internet lists:

  1. Public Zoos—From Abilene, Texas, to St.-Félicien, Quebec (including zoos in the UK, Switzerland, Mexico, Germany, and throughout the United States)
  2. Zoo Organizations—Includes the American Zoo and Aquarium Association and the International Species Information System
  3. Zoo-Related Links—Includes ZooNet (the place to go when you want to know about zoos)
  4. Animal-Related Links—Links from *African Primates at Home* to *The Wildlife Web*
  5. Animal Photos—A very large selection of animal pictures, but it's a good idea to screen the sites before adding them to your own list. You will also want to check that the format is compatible with your computer system.
  6. Animal Sounds—An interesting and noisy site

- www.lpzoo.org/animals
  The main menu for the Lincoln Park Zoo in Chicago. It allows students the opportunity to research a variety of animals and also reports on current events and activities.

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Math at the Zoo:

Books and Web Sites (continued)

- http://nationalzoo.si.edu/animals
  The home page for the National Zoo in Washington, DC, includes some interesting pictures and information about the zoo.
- http://animaldiversity.ummz.umich.edu/
  A wonderful site that has remarkable information about mammals, birds, amphibians, reptiles, sharks, and more. It is sponsored by the University of Michigan Museum of Zoology.
- http://netvet.wustl.edu/e-zoo.htm
  The Electronic Zoo is a Web site sponsored by Washington University. It is wonderful for younger children. Check it out to see all of the information resources available.

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Math and Personal Fitness

It has been said that the key to good health is diet and exercise. Personal trainers and nutritionists are the people we turn to when we are "looking for the road to good health." As in all real-world professions, mathematics plays an important role in these occupations.

Personal trainers provide individualized exercise (and sometimes diet) portfolios for their clients. They must have a good understanding of the life-styles and health requirements of their clients. There are certified personal trainers and aerobics instructors who receive specialized instruction on nutritional needs, exercise requirements, and other health concerns.

Nutritionists are trained to regulate and give information on diets, menus, and recipes that supply nutritional needs while addressing any health concerns or problems their clients may have.

The mathematics of personal fitness and nutrition includes an understanding of computation, using formulas and substituting into these formulas, working with percentages, and problem solving.

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Finding Your Heart Rate

Math Skills

- Measuring
- Finding percentages
- Collecting and organizing data
- Computing and solving problems

Materials Needed

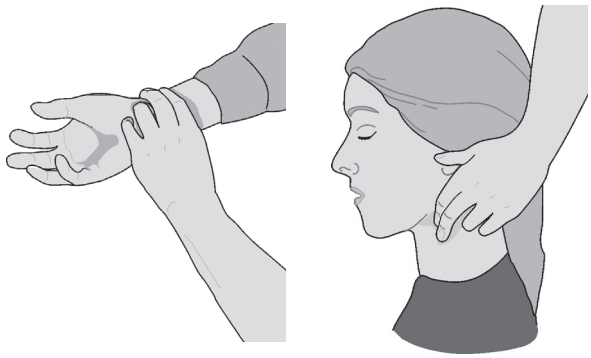
- "Finding Your Heart Rate" activity sheet (p. 132) for each student
- Watch or clock with a second hand
- Calculators

Background Information and Suggested Teaching Strategies

This activity asks students to take their pulse (heart rate) while at rest and use that data to calculate their target heart rate using a formula developed by the American College of Sports Medicine. This organization recommends exercising at an intensity of between 60% and 90% of one's maximum heart rate. What is the purpose of using these training ranges? In order for a workout to be effective, it is necessary to get your heart rate up to at least the lower end on the range, the threshold heart rate, where there is enough stress to encourage cardiovascular strength. The upper end of the range, the target ceiling rate, is the maximum limit at which an individual wants to stress the cardiovascular system. When one goes above this upper limit, there is no further beneficial effect and the heart can be taxed.

Students begin by taking their heart rate at rest. The diagrams below show two areas where you can take a pulse. The first is on the wrist using two or three fingers placed almost directly below the thumb. The second is on the neck using two or three fingers placed almost directly under the ear.

Note: Do not use your thumb because you may get a false reading. It may be necessary to walk around the room and help students find their pulse.



wrist pulse ***neck pulse***

It might be helpful to make copies of these diagrams for students to use. The resting heart rate obtained by each student is used in the formula to find their personal target heart rate. Before a child reaches the age of one, his or her resting heart rate can range from 100–160 beats per minute (bpm). As we mature, our resting heart rate drops to between 60 and 100 bpm. The range is based upon fitness levels—the more in shape a person is, the lower his or her resting heart rate.

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Communicating through Journaling

Why do you think a person's age was first subtracted from 200—the maximum heart rate—before finding the threshold and target ceiling heart rates? Explain your answer.

Answer: Answers may vary but by first subtracting a person's age, the initial maximum is lowered to consider the physical changes that occur with the aging process. For example, at 20 years of age, a person is calculating 60% and 90% of 180 to find their threshold and ceiling heart rate. But at 50 years of age, a person is calculating the same percentages using 150.

Possible Extension Ideas

The data collected from each member of the class can be entered on a class data table and used for statistical analysis. Students can find the range of the data, the mean, median, and mode.

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Name _____ *Date* _____

Finding Your Heart Rate

Imagine a pump that weighs about $\frac{1}{2}$ pound (about the size of a clenched fist) and works 24 hours a day for about 70 years. It has the power of a champion athlete and every hour produces enough energy to raise a small car off the ground. This remarkable pump is the human heart!

How many times do you think your heart beats in one day? In one year? Let's find out.

Directions: Use a watch with a second hand to count the number of times your heart beats in 15 seconds. Then use this data to compute the beats per minute, per day, and per year. Record all information on the following table.

Finding Your Resting Heart Rate				
Your Name	***Beats/15 sec.***	***Beats/min.***	***Beats/day***	***Beats/year***

During exercise, it is important to know your target heart rate. This statistic has two parts: The threshold heart rate is the lower end of the range. It represents the slowest your heart should be beating for you to obtain any benefit from the exercise. The *target ceiling heart rate* indicates the fastest your heart rate should be without taxing your heart. Use your resting heart rate (beats/min) and follow these directions to find your own personal target heart rate.

Finding Your Target Heart Rate	
Step 1: Subtract your age from 220.	
Step 2: Subtract your resting heart rate (in beats/minute) from the difference obtained in Step 1.	
Step 3: Find 60% of your answer from Step 2.	
Step 4: Add your resting heart rate to your answer in Step 3. This is your threshold heart rate.	
Steps 5 and 6: Repeat steps 1 and 2.	
Step 7: Find 90% of your answer from Step 6.	
Step 8: Add your resting heart rate to your answer in Step 7. *This is your target ceiling heart rate*.	

My target heart rate is between _____ and _____ beats per minute.

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Our Basal Metabolism Rate

Math Skills

- Substitution into a formula
- Measuring
- Computing

Materials Needed

- "Our Basal Metabolism Rate" activity sheet (p. 135) for each student
- Calculators

Background Information and Suggested Teaching Strategies

Students may be familiar with the term *metabolism* but chances are they have no idea of what our metabolism rate actually means. The Basal Metabolism Rate (BMR) represents the minimum number of calories needed to sustain life in a resting individual if we stayed in bed all day long. BMR can be responsible for burning up to 70% of the total numbers of calories we use each day. Our body's systems work very hard to do their job!

It is important that students understand that their caloric intake requirement differs substantially from that of adults. It is also important that students understand that to keep themselves healthy they must have an adequate caloric intake. The body of an adolescent is growing at a rapid rate both internally and externally. This period of rapid growth requires a higher BMR. When a student's caloric intake becomes too low for his or her body to maintain itself, it goes into "starvation mode" and the metabolism slows down.

Most of the Harris Benedict Formulas are shown in metric measurements. The two on the student activity sheet have been converted to customary units of measure. If you wish students to calculate the problems using metric units, use the following converted formulas, which have been rounded to the nearest kilogram and nearest $\frac{1}{10}$ of a meter:

Problem 3: A 35-year-old woman weighs 61 kilograms (kg) and is 1.6 meters (m) tall.

Problem 4: A 50-year-old man weighs 79 kg and is 1.8 m tall.

The metric versions of The Harris Benedict Formula are:

Women: BMR = 655 + (9.6 × wt (kg)) + (1.8 × ht (cm)) – (4.7 × age (yrs))

Men: BMR = 66 + (13.7 x wt (kg)) + (5 × ht (cm)) – (6.8 × age (yrs))

Communicating through Journaling

Experts tell us that an adolescent girl requires 22 calories per pound of body weight each day. A seventh-grade girl who weighs 110 lb and is 52 in. tall used the Harris Benedict formula for women 655 + (4.35 × weight (lbs)) + (4.7 × height (in.)) – (4.7 × age (yrs)) to calculate the number of calories she required.

1. How many calories did she estimate she needed (by using this formula calculated for use by adults)?
2. What is the difference between the number of calories the experts say an adolescent needs and those of an adult?

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3. Do you think her body might go into "starvation mode"?

Explain your answers and show all of your work.

Answers: For this problem we will assume that a seventh-grade girl is 12 years old.

1. Substituting into the formula given:
   $655 + (4.35 \times 110) + (4.7 \times 52) - (4.7 \times 12)$
   $655 + 478.5 + 244.4 - 56.4 = 1{,}321.5$ calories
2. Using the recommendations of experts, a 12-year-old girl requires 22 calories per pound of body weight: 22 calories × 110 lb = 2,420 calories. So the difference is 2,420 – 1,321.5 or 1,098.5 calories less than the experts suggest.
3. To lose one pound of fat, it is necessary to take in 3,500 fewer calories. If the girl's metabolism remained unchanged, she would lose approximately one pound every 3.5 days. It is possible that her body would go into "starvation mode" to maintain itself.

Possible Extension Ideas

There are many other factors that have an effect on the BMR that are not examined in this activity. Some of these are gender, age, and weight. Also, the BMR is increased by exercise. Activity multipliers are used to calculate a revised BMR based upon the amount of activity. These are:

Sedentary = BMR × 1.2 (little or no exercise)

Lightly active = BMR × 1.375 (light exercise/sports 1–3 days/week)

Moderately active = BMR × 1.55 (moderate exercise/sports 3–5 days/week)

Very active = BMR × 1.725 (hard exercise/sports 6–7 days/week)

Have students determine how diet and exercise are interrelated. Students who wish to eat more food but maintain the same weight can use the 22 calories or 25 calories times the weight rule and then multiply by the activity rates. What conclusions do they draw?

Activity Answers

Answers have been rounded to the nearest calorie.

1. 3,125 calories
2. 2,090 calories
3. ≈ 1,379 calories
4. ≈ 1,718 calories

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Name _____ *Date* _____

Our Basal Metabolism Rate

The Basal Metabolism Rate (BMR) is the minimum caloric requirement needed to sustain life in the person at rest. In other words, it is the minimum amount of energy needed (as measured in calories) a person needs if *he or she stayed in bed all day!* We burn calories to get the energy we need to breathe, to pump blood around our bodies, and to maintain our body temperature. When we take in more calories than are needed, we gain weight; when we take in fewer calories than are needed, we lose weight.

How many calories do we need? For individuals under the age of 18, there is a simple rule—to maintain your desired body weight, multiply your desired weight by 25 (if you are a boy) and 22 (if you are a girl). Using this rule, solve these two problems:

1. Marcus is 14 years old and his desired weight is 125 pounds. About how many calories would he need to take in each day to maintain this weight? _____

2. Alice is 12 years old and her desired weight is 95 pounds. About how many calories would she need to take in each day to maintain this weight? _____

For people over the age of 18, the Harris Benedict formula is used to calculate how many calories an individual needs but, unfortunately, this formula is not at all accurate for those younger than 18. Because adolescence is a time when many changes occur in the body, extra energy is needed. Young people require more calories as support during this rapid period of growth.

However, personal trainers who work with adults to help them with nutritional needs use the Harris Benedict formula. This formula indicates the number of calories a person needs to take in each day to maintain their bodily functions at a state of complete rest. There are two formulas—one for men and one for women:

Women: BMR = 655 + (4.35 × weight (lbs)) + (4.7 x height (in.)) – (4.7 × age (yrs))

Men: BMR = 66 + (6.23 × weight (lbs)) + (12.7 × height (in.)) – (6.8 × age (yrs))

3. A 35-year old woman weighs 135 pounds and is 5'4" tall. What is her BMR? _____

4. A 50-year old man weighs 175 pounds and is 5'11" tall. What is his BMR? _____

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Estimated Energy Requirements

Math Skills

- Substituting in a formula
- Using order of operations
- Reading tables and charts
- Measuring
- Converting from customary to metric units
- Calculating with integers

Materials Needed

- Background Information sheet (p. 138) for each student
- "My Personal EER" activity sheets (pp. 139 and 140) for each student
- Meter sticks or metric tape measures for each pair of students
- Overhead transparencies of the Background Information sheet and of the "My Personal EER" activity sheets
- Calculators

Background Information and Suggested Teaching Strategies

Unlike the formulas used in the previous activity, the estimated energy requirement formulas determine calorie levels for individuals ages 2 to adult. In addition, this formula factors in a number of different variables—gender, age, weight, height, and level of physical activity. It is suggested in the activity that students estimate their weight (rather than get on a scale) because this can be a very sensitive issue with adolescent youngsters. In the previous activity, activity levels are discussed and somewhat defined. You can review those with students.

Sedentary: little or no exercise

Lightly active: light exercise/sports 1–3 days per week

Moderately active: moderate exercise/sports 3–5 days per week

Because the EER formula (shown on the Background Information sheet) is so complicated, it is a good idea to do a sample with students to better acquaint them with the order of operations. Make an overhead transparency of the "My Personal EER" activity sheets to show to the class and write the following information in the required spaces. Explain to students that the example uses a male with the following data:

AGE: 13 years; PA level: 1.26; WT: 56.25 kg (125 lb); HT: 1.7 m (68 in.)

$EER = 88.5 - (61.9 \times 13) + 1.26 \times [(26.7 \times 56.25) + (903 \times 1.7)] + 25$

$EER = 88.5 - 804.7 + 1.26 \times [1{,}501.875 + 1{,}535.10] + 25$

$EER = 88.5 - 804.7 + 1.26 \times 3{,}036.975 + 25$

$EER = 88.8 - 804.7 + 3{,}826.5885 + 25$

$EER = 3{,}110.388525$ or approx. 3,110 calories

As you work the formula with students, you may find that they are distressed that their first operation in the last step gives them a negative number. Remind them that when they add the large positive number that follows, their EER will become a positive number.

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Students can share meter sticks but each student needs his or her own copies of the information and activity sheets. Be sure to read the Background Information with students so that they understand the difference between the formulas and that kilograms and meters are needed to substitute into the formula. The conversion factors are on the bottom of the activity sheet. Because students will probably measure their height in centimeters, it will be necessary to review conversions within the metric system.

As the EER formula factors in age, gender, height, weight, and level of physical activity, it is a fairly accurate way for students to calculate the number of calories they need to remain healthy. This becomes a good lead-in activity to nutrition.

Communicating through Journaling

Show how to solve this problem using order of operations: $9 - 5 \div (8 - 3) \times 2 + 6$. Explain why it was so important to follow the order of operations when you computed your personal EER.

Answer: Using the order of operations, the solution to this problem is 13. Without using order of operations, there are many possible incorrect solutions.

Possible Extension Ideas

Following up on practice using order of operations, place students in groups of two and give them the following problems: $(3 + 4) \times 2$ and $3 + 4 \times 2$. Ask each pair of students to write a story problem for each of these two problems. Have them share their problems with the class.

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Background Information

Estimated Energy Requirement (EER) is another way to look at the amount of energy intake needed to maintain energy balance in a healthy person. Like the BMR, it too depends on gender, age, weight, height, and physical activity level. But, unlike BMR, this formula has been developed for individuals from 2 years to adult. This is a table of the formulas used at the various age levels:

Estimated Energy Requirement Formulas (EER)		
Age	***Gender***	***Formula***
2 years	Male	(89 × WT – 100) + 20
	Female	(89 × WT – 100) + 20
3–8 years	Male	88.5 – (61.9 × AGE) + PA × [(26.7 × WT) + (903 × HT)] + 20
	Female	135.3 – (30.8 × AGE) + PA × [(10 × WT) + (934 × HT)] + 20
9–18 years	Male	88.5 – (61.9 × AGE) + PA × [(26.7 × WT) + (903 × HT)] + 25
	Female	135.3 – (30.8 × AGE) + PA × [(10 × WT) + (934 × HT)] + 25
Adult (over 18)	Male	662 – (9.53 × AGE) + PA × [(15.91 × WT) + (539.6 × HT)]
	Female	354 – (6.91 × AGE) + PA × [(9.36 × WT) + (726 × HT)]

Note: HT (height) in meters, WT (weight) in kilograms, PA (physical activity) based upon the level of physical activity. The table below shows substitutions for PA.

Age	***Gender***	***Level***	***Number for PA***
9–18	Male	Sedentary	1.00
		Lightly Active	1.13
		Moderately Active	1.26
9–18	Female	Sedentary	1.00
		Lightly Active	1.16
		Moderately Active	1.31

Before you can begin this activity, you need to collect some data. Work with your group to complete the data table on the next page and then calculate your individual EER using the formulas above. Remember:

- ☞ 100 cm = 1 m
- ☞ 1 in ≈ 2.54 cm
- ☞ 1 lb ≈ 0.45 kg

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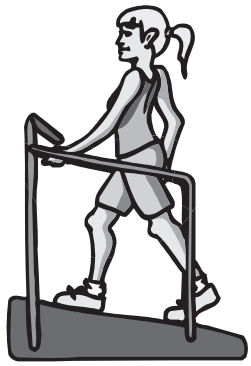
Name _____ *Date* _____

My Personal EER, Page 1



Substitute your own data into the EER formulas to help you calculate your own personal Estimated Energy Requirement. Follow these steps:

1. Convert your personal data into metric units.
2. Substitute your data into the appropriate formula. Be sure to place all parentheses and brackets in the formula.
3. Follow the order of operations to solve the problem.

The formulas shown are for males and females between the ages of 9 and 18.

Male	88.5 – (61.9 AGE) + PA × [(26.7 × WT) + (903 × HT)] + 25
Female	135.3 – (30.8 × AGE) + PA × [(10 × WT) + (934 × HT)] + 25

My Personal Data Converted into Metric Units

My age: _____ My weight in kg: _____

My height in m: _____ My PA: _____
(based upon my level of physical activity)

The EER Formula with My Personal Data

EER = _____

My calculations (Show all work here.):

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Name _____ *Date* _____

My Personal EER, Page 2

Use the information on page 1 to complete this data collection activity and find your personal EER. Follow these directions:

1. Measure the height of each person in your group in centimeters (cm) and then convert these measurements to meters (m). Enter height in meters on the table.
2. Estimate weight in pounds (lbs) and then convert these measurements to kilograms (kg) and enter kilograms on the table.
3. Estimate your activity level and enter that on the table.
4. Find the appropriate formula on the previous page.
5. Using a calculator, substitute your personal data into the appropriate EER formula to find your own Estimated Energy Requirements.

Name	*Height (in m)*	*Weight (in kg)*	*Activity Level Coefficient*

Use this table and the appropriate formula to calculate your personal EER.

Name	*Calculations*	*My EER*

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Walking for Your Health

Math Skills

- Problem solving using geometry
- Measuring
- Computing perimeter and circumference

Materials Needed

- "Walking for Your Health" activity sheet (p. 142) for each student
- Overhead transparency of student activity sheet
- Calculators

Background Information and Suggested Teaching Strategies

Ask students how they might calculate the distance around the track knowing that there are semi-circles at the ends. Be sure they understand that the circular parts of the track have a diameter of 50 ft and the remainder of the track is parallel lines with a length of 250 ft. Give students the opportunity to discuss alternative strategies. Two geometry terms used in this activity are *perimeter* and *circumference*. Have students calculate the circumference using 3.14 as the approximate value of π.

Communicating through Journaling

A circular track has a radius of 50 feet. What is the distance around the track? Explain how you solved this problem. (Use 3.14 for π.)

Answer: To find the circumference of a circular track, use the formula: $C = \pi d$ or $C = 2\pi r$. The diameter of this circle is 100 ft. $C = 3.14 \times 100$; $C = 314$ ft.

Possible Extension Ideas

1. There are many areas in a gymnasium that are painted using circular regions. Have students measure the diameters of these regions in your school gym and calculate the circumference of each of these circular areas.
2. Another possible extension is to find the area inside the 3-point line on a basketball court using the formula $A \approx \pi r^2$.
3. Last, have students search the Internet for the many advantages there are to walking for your health.

Activity Answers

These are possible solutions and answers to the problems on the student sheet:

1. Add up the parallel sides: 250 + 250 = 500 ft.

   Find the circumference of each semi-circle and multiply by 2:

   $$\frac{\pi d}{2} = \frac{C}{2} = \frac{157}{2} = 78.5$$

   $78.5 \times 2 = 157$

   157 ft + 500 ft ≈ 657 ft.

2. 5,280 ft ÷ 657 ft ≈ 8 laps × 3 ≈ 24 laps

3. In one week she walks approximately 9 miles.

   In one year she walks 468 miles.

4. She burns 46,800 calories in one year.

   46,800 calories ÷ 3,500 calories ≈ 13 lbs

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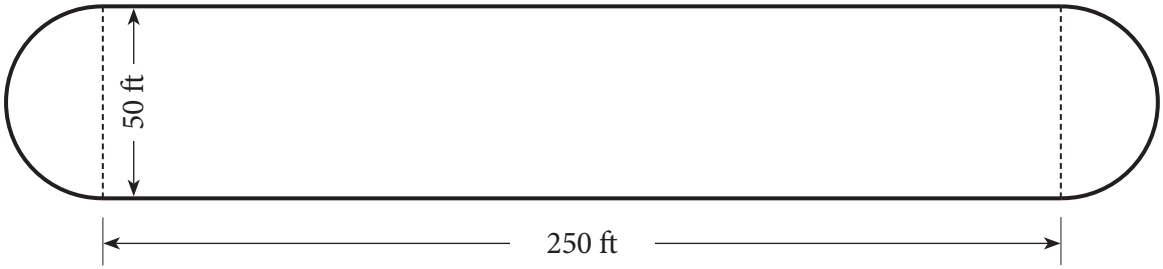
Name _____ *Date* _____

Walking for Your Health

Walking is the most popular form of exercise. While other forms of exercise get more publicity, none of them approaches the popularity of walking! Approximately half of Americans claim they exercise on a regular basis, and the number of people who walk increases every day. Walking on a regular schedule helps improve the body's ability to consume oxygen, lowers the resting heart rate, reduces blood pressure, and increases the efficiency of the heart and lungs. And, for those people who want to lose weight, it also helps burn excess calories.

Directions: The diagram below represents a walking track at a local health club. Use the information and measurements given to help you answer the questions that follow. Be sure to show all of your work.



1. A person exercising takes one lap around this track. About how far would she be walking? (Use 3.14 for π.) _____

2. Suppose this person wants to walk 3 miles. About how many laps around the track would she need to walk? _____

3. If she walks the same distance 3 times per week, how many miles does she walk? _____

How many miles does she walk in one year? _____

4. On average, a person burns 100 calories for each 1 mile that they walk and loses 1 lb of weight for every 3,500 calories that they burn. How many calories are burned in one year? _____

How many pounds does this exerciser lose in one year by just walking? _____

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How Many Calories in a Cookie?

Math Skills

- Solving problems
- Computing percentages
- Using measuring to compute calories

Materials Needed

- "How Many Calories in a Cookie?" activity sheet (p. 144) for each student
- Calculators (optional)

Background Information and Suggested Teaching Strategies

We have all seen the number of calories listed on package labels. But do we really know how they are calculated? Are those calculations correct?

This activity gives students a recipe for oatmeal raisin cookies and the number of calories in each unit of ingredient. These units are usually given as cups. If the recipe calls for 1 cup of butter, then students can just copy the calorie amount into the "Total" column. If, however, the recipe calls for $1\frac{1}{2}$ cups, students will need to find $1\frac{1}{2}$ times the number of calories listed per cup.

After finding the total number of calories in the recipe, students must find the number of calories in each cookie and the percentage of calories from each type of ingredient.

Communicating through Journaling

A recipe that makes 5 dozen sugar cookies has approximately 7,700 total calories. About how many calories are in each cookie?

Answer: Calculate the number of cookies in 5 dozen and then divide the total number of calories by that number. $12 \times 5 = 60$ cookies; 7,700 calories $\div$ 60 cookies $\approx$ 128 calories.

Possible Extension Ideas

Have students bring in a recipe from home. Using a reference book that contains calories in each ingredient or using the Internet (see http://www.calorieking.com/foods), they can calculate the number of calories in a reasonable portion of that recipe.

Activity Answers

The answers below have been rounded to the nearest percent.

Total calories for each ingredient:

Butter	1,628
Sugar	385
Brown sugar	829
Eggs	714
Flour	682.5
Oatmeal	441
Raisins	78
Baking soda	0
Cinnamon	0
Vanilla	0
Total calories in recipe	4757.5
Total calories in each cookie	132

Percentage of calories in each:

1. Fat (butter): 34%
2. Sugars (white and brown): 26%
3. Flour and oatmeal: 24%
4. Eggs: 15%
5. Raisins: 2%

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Name _____ *Date* _____

How Many Calories in a Cookie?

This recipe makes 3 dozen oatmeal raisin cookies.

Directions:

1. Calculate the total number of calories in each of the ingredients.
2. Next, find the total number of calories in the recipe.
3. Last, find the number of calories in each cookie.

Ingredient	*Amount needed in recipe*	*Calories per unit*	*Total calories for this ingredient*
Butter	1 cup	1,628 per cup	
Sugar	$\frac{1}{2}$ cup	770 per cup	
Brown sugar	1 cup	829 per cup	
Eggs	2	357 per egg	
Flour	$1\frac{1}{2}$ cups	455 per cup	
Oatmeal	3 cups	147 per cup	
Raisins	1 cup	78 per cup	
Baking Soda	1 teaspoon	0	
Cinnamon	1 teaspoon	0	
Vanilla	1 teaspoon	0	
Total calories in recipe			
Total calories in each cookie			

Find the percentage of calories in each:

1. Fat (butter): _____
2. Sugars (white and brown): _____
3. Flour and oatmeal: _____
4. Eggs: _____
5. Raisins: _____

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Reading Product Labels

Math Skills

- Collecting and analyzing data
- Working with metric units
- Finding percentages
- Using computation to solve problems

Materials Needed

- "Reading Product Labels" activity sheets (pp. 146 and 147) for students
- Calculators (optional)
- Overhead transparency of page 146 (Nutrition Facts label)

Background Information and Suggested Teaching Strategies

Federal guidelines require all product labels to contain the same information. It is interesting to note that the guidelines do not indicate what a "serving size" should be and very often the serving size listed is not realistic—it is too small. This is done to make the number of calories in the food look reasonable. The larger the serving size, the larger the number of calories. As students work on this activity and use their own product labels and those found on the Internet, be sure they understand the need to accurately represent typical serving sizes.

The initial questions lead students through any product label. They will calculate and analyze the amount of calories, fats, and carbohydrates in these crackers.

After students analyze this label, they can bring a label from home (or use a Web site such as http://www.calorie-count.com/ to find a label) to analyze. Ask students to share the information about their personal snack label with the rest of the class.

Communicating through Journaling

It is recommended that we keep our intake of sodium (salt) to less than 2,400 mg each day. A label of chicken noodle soup states: "1 cup of soup contains 1,106 mg of sodium." What percent of the recommended daily allowance of sodium is there in one serving the this chicken noodle soup? Explain how you solved this problem.

Answer: Students may use different strategies to solve this problem but 1,106 is 46% of 2,400.

Possible Extension Ideas

Have students visit the Web site at http://teamnutrition.usda.gov/resources/mpk3_lesson1.pdf. It gives students information about eating correctly using the USDA's recommendations. It contains ready-to-use activity sheets to help students analyze their own eating habits. There are other activities on this site as well that would be very helpful in teaching a unit on nutrition.

Activity Answers

1. 2 crackers

2. approximately 42 crackers

3. 1.5 grams

4. 13.5 calories

5. 22.5% of the calories are fat calories

6. 10 grams

7. 40 calories

8. $66\frac{2}{3}$ % of the calories are carbohydrate calories. It appears that this is probably a healthy snack in that it has no cholesterol, is low in fat, and does not have a great deal of sodium (70 mg is only 3% of the recommended amount of sodium intake).

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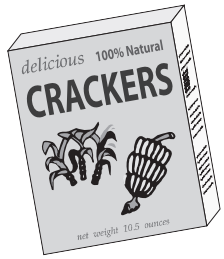
Name _____ *Date* _____

Reading Product Labels



This is a product label for a popular brand of crackers. All product labels are required to have certain information. We'll start at the top of the label:

Nutrition Facts

Serving Size 2 crackers (14g)
Servings Per Container About 21

Amount per Serving
Calorie 60 **Calories from Fat** 15

	% of Daily Value*
Total Fat 1.5g	**2%**
Saturated Fat 0g	**0%**
Trans Fat 0g	**0%**
Cholesterol 0mg	**0%**
Sodium 70mg	**3%**
Total Carbohydrates 10g	**3%**
Dietary Fiber < 1g	**3%**
Sugars 0g	**0%**
Protein 2g	

Vitamin A 0% • Vitamin C 0%

Calcium 0% • Iron 2%

*Percent Daily Values are based on a 2,000 calorie per day diet. Your daily levels may be higher or lower depending on your calorie needs.

	2,000 Calories/day
Total Fat	< 65g
Saturated Fat	< 20g
Cholesterol	< 300mg
Sodium	< 2400mg
Total Carbohydrate	300g
Dietary Fiber	25g

Analyzing the Label

1. The first information on the label under "Nutrition Facts" is serving size. What is the suggested serving size? _____

2. The label lists "Servings Per Container." Given this information, approximate the number of crackers in the entire package. _____

3. How many total grams of fat are there in a serving? _____

4. Each gram of fat contains 9 calories. How many total fat calories are there in a serving? _____

5. What percentage of the total calories in each serving are fat calories? _____

6. How many total grams of carbohydrates are there in a serving? _____

7. Each gram of carbohydrate contains 4 calories. What percentage of the calories in a 2-cracker serving are carbohydrate calories? _____

8. Looking at this label, do you think this cracker might be part of a "healthy snack?"

   Explain your answer. _____

_____

_____

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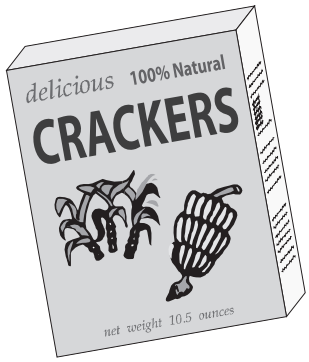
Name _____ *Date* _____

Reading Product Labels (continued)



Finding Your Own Label

Find a product label on a snack you have at home or use the Internet to find a product label for snacks. An interesting site is http://www.calorie-count.com/.

Do an analysis of your own product label answering the same questions that are in this activity. Decide which of the snacks is a healthier snack and why. Glue your product label here and then write your analysis.

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The USDA's New ChooseMyPlate

Math Skills

- Reading tables and graphs
- Collecting, organizing, and analyzing data
- Graphing
- Using the Internet to research
- Using formulas
- Finding percentages

Materials Needed

- The New USDA's Choose**MyPlate** activity sheets (pp. 150, 151, 152, and 153) on for each group of 4 students
- 1 die per group
- Internet access
- Overhead transparency or activity sheets

Background Information and Suggested Teaching Strategies

The USDA has a poster available to schools at http://www.choosemyplate.gov/print-materials-ordering.html and graphic materials are available at http://www.choosemyplate.gov/print-materials-ordering/graphic-resources.html

The home page is http://www.choosemyplate.gov/

All information and documents on this site are in the public domain and can, therefore, be copied and used in the classroom.

Assign students into groups-or-four for this activity. Each group will do all six of the activities on the activity sheet. By rolling one die, they determine which activity they are to do. If the roll a number of an activity they've completed, they continue to roll until they get a number of an activity that they have not yet done.

Activity 2 and Activity 3 asks students to collect data. A table has been supplied for both of these activities. Page 152 has a table that helps students collect the data for "My Favorite Fruit" survey. There is also room on this sheet for students to design a pie graph using the data collected in their survey. Activity 3 requires that the individual members of the group complete the table and design "My Vegetable Menu". They are then encouraged to share their selections for with rest of their group, and if you wish, with the class.

Note: Activities 2 and 5 require students to survey other students. Activity 2 is a survey, "My Favorite Fruit" and Activity 6 is a "blind milk tasting test". To avoid the same students being surveyed more than once, perhaps each group should be assigned certain classes so there is no duplication of participants. Also be sure to make students to be careful to ask if a student is lactose intolerant.

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Communicating through Journaling

1. A McDonald's Quarter Pounder® contains 420 calories. There are 25 grams of total fat in each hamburger. If each gram of fat contains 9 calories, how many calories in the hamburger are from fat? What percent of the hamburger's calories are from fat? Explain how you solved this problem.
2. There are 730 milligrams (mg) of sodium (salt) in each hamburger. The daily intake levels of sodium should be less than 2500 mg. What percent of the maximum daily intake level of sodium is there in this hamburger? Explain how you solved this problem.

Answers:

1. $25 \times 9 = 225$ calories from fat;
   $225 \approx 54\%$ of 420 total calories
2. 730 is 29% of 2,500

Possible Extension Ideas

Most of the time students are unaware of the nutritional value and calories in the foods they eat. The materials in the USDA Web site that explore nutritional information, diets, and exercise are excellent and can be used as part of an interdisciplinary unit on math, science, and nutrition.

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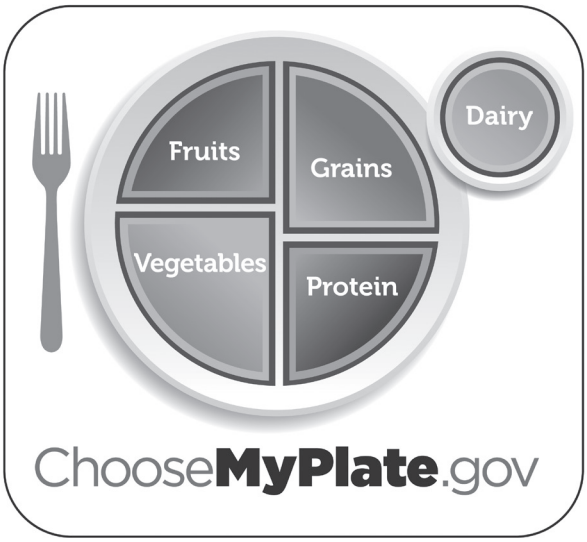


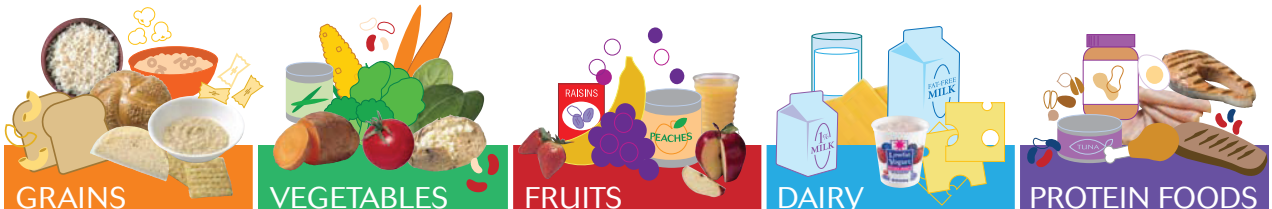
The U.S. Department of Agriculture (USDA) has released new guidelines for a healthy diet. The MyPlate guidelines are designed to remind us, visually, what it means to "eat healthy". The size of each section on the plate indicates the importance of that item to a healthy menu.

My Daily Food Plan explains what the USDA has developed as the food requirements for young people between the ages of 9 and 17.

Go to http://www.choosemyplate.gov/supertracker-tools/daily-food-plans.html to design your own daily food plan.

My Daily Food Plan

Based on the information you provided, this is your daily recommended amount for each food group.



GRAINS 7 ounces	VEGETABLES 3 cups	FRUITS 2 cups	DAIRY 3 cups	PROTEIN FOODS 6 ounces
Make half your grains whole Aim for at least **3 1/2 ounces** of whole grains a day	**Vary your veggies** Aim for these amounts **each week:** **Dark green veggies** = 2 cups **Red & orange veggies** = 6 cups **Beans & peas** = 2 cups **Starchy veggies** = 6 cups **Other veggies** = 5 cups	**Focus on fruits** Eat a variety of fruit Choose whole or cut-up fruits more often than fruit juice	**Get your calcium-rich foods** Drink fat-free or low-fat (1%) milk, for the same amount of calcium and other nutrients as whole milk, but less fat and Calories Select fat-free or low-fat yogurt and cheese, or try calcium-fortified soy products	**Go lean with protein** Twice a week, make seafood the protein on your plate Vary your protein routine—choose beans, peas, nuts, and seeds more often Keep meat and poultry portions small and lean

Find your balance between food and physical activity
Be physically active for at least **60 minutes** each day.

Know your limits on fats, sugars, and sodium
Your allowance for oils is **6 teaspoons** a day.
Limit Calories from solid fats and added sugars to **270 Calories** a day.
Reduce sodium intake to less than **2300 mg** a day.

Your results are based on a 2200 Calorie pattern. **Name:** _____

This Calorie level is only an estimate of your needs. Monitor your body weight to see if you need to adjust your Calorie intake.

Source: U.S. Department of Agriculture. Choose**MyPlate**.gov

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The USDA's New ChooseMyPlate

Directions: Roll one die and work with you group of four on the activity that matches the number on you die. If you have already completed that activity, roll the die until it lands on an activity you have not completed. Check off each activity on the next page as you complete it. Make sure each member of your group has signed his or her name. **The USDA's MyPlate explains what a healthy diet is for everyone, including young people of your age. By going to http://www.choosemyplate.gov/food-groups/ and choosing the food group you need to research, your group will find the answers to these questions.**

1	2	3
The USDA recommends certain grains because not all grains are equal. Click on the Grains Group link of the URL shown in the directions to answer these questions: • What's in the Grain Group? • What counts as an ounce? • What health benefits do we get from grains? Discuss with your group, which whole grains appeal to you and why you might add these to your diet.	A large section on MyPlate is the Fruit Group. Click on http://www.choosemyplate.gov/food-groups/fruits.html to help you make up survey. You will need to choose 5 or 6 choices. This project will require your group to: 1. Survey 25 students. Collect your data on the table on page 152. 2. Use the data to design a graph to display your results. 3. Each group member must use a word processing program to write an individual report explaining your group's results.	Each person in your group is to develop their own "My Vegetable Menu". Go to: http://www.choosemyplate.gov/food-groups/vegetables_amount_table.html to find the recommended total daily amounts of vegetables you should be eating each day. Then click on the link provided on this page to find the amount that counts as 1 cup of the vegetables you added to your weekly on MyPlate menu. Read over each of the vegetables listed and choose carefully. Use the table provided on page 154 When you have completed your menu, share it with others in your group.
4	**5**	**6**
Go to www.fastfoodnutrition.org to find your favorite fast-food restaurant chain. Choose a complete meal from their menu and analyze the number of calories in the meal, grams of fat, carbohydrates, sodium, and so on. Write an short report on the meal you chose. Then choose another meal (either from the same restaurant or choose another) that might be healthier for you. Explain why you believe it is healthier.	An 8-oz serving of fat-free milk has 90 calories, 2% milk has 130 calories, and whole milk has 150 calories. Organize a "blind taste test"—which means that the students you are surveying do not know which choice is which—survey 30 students. (Be sure they have not been surveyed by another group.) Have them indicate which milk tastes the best. Then organize your results, draw a graph, and write a short report on your results.	We have all heard of foods that have "empty calories". What are they? Learn more about by going to http://www.choosemyplate.gov/food-groups/emptycalories_count_table.html Calculate the food in each food group that your group has the greatest percentage of empty calories. To find the percentage use this formula: $\text{Percentage} = \frac{\text{Estimated empty calories}}{\text{Estimated total calories}}$ Using the same formula, calculate the food in each group that has the lowest percentage of empty calories. Do you think this might change the choices you make? Discuss this as a group and be ready to share your thoughts with the class.

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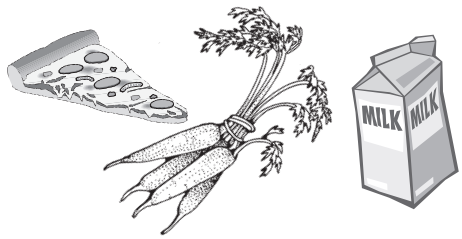
The USDA's New ChooseMyPlate (continued)



We have completed	*Signature of each group member*	
❒ Activity 1		
❒ Activity 2		
❒ Activity 3		
❒ Activity 4		
❒ Activity 5		
❒ Activity 6		

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The USDA's New ChooseMyPlate (continued)

Group Members: _____ _____

_____ _____

_____ _____

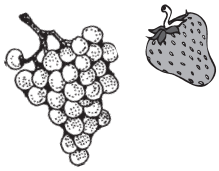
Our Fruit Group Survey

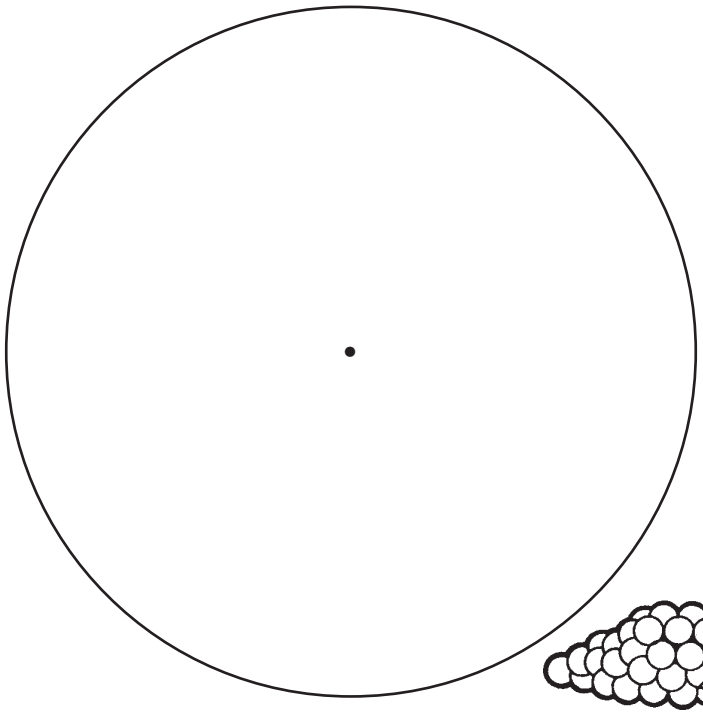
Question: Of these choices, what is your favorite fruit?

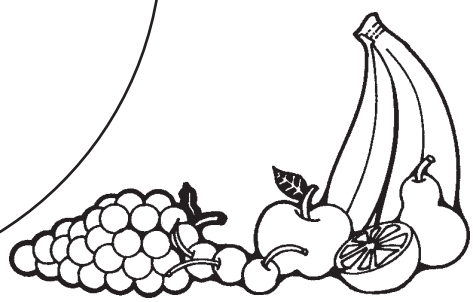
Fruit	*Tally*	*Frequency*	*Fraction*	*Percent*

Our Graph

Directions: Design a pie graph to represent the data you collected in your survey.







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Name _____ *Date* _____

My Vegetable Menu

My daily requirement in cups: _____

My weekly requirement in cups: _____

Directions: Choose at least three vegetables from the link shown in choice #3 of the New USDA's New Choose**MyPlate** activity sheet. List them on the table below. If you are supposed to eat 2 cups of vegetables each day and you don't have to each the same ones every day. So you can list 8 different vegetables on the table and decide on which days you will eat each of them. You can split up the amount of each of the vegetables you choose, as well. For example, if you choose corn and mashed potatoes for one of the days, you can eat 1 cup of each. You can also eat ½ cup of four different vegetables on any one day. Try to vary the types of vegetables you eat each day and http://www.choosemyplate.gov/food-groups/vegetables-why.html will help you decide the health benefits of each.

Number of cups for each day

Vegetable	*Monday*	*Tuesday*	*Wednesday*	*Thursday*	*Friday*	*Saturday*	*Sunday*
Totals							

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Math and Personal Fitness:
Books and Web Sites

Books for Students

- Gray, S. W. *Exercising for Good Health*. Chanhassen, MN: Child's World, 2003.
  The author does an excellent job of making exercise seem more like play and less like work. The book highlights lots of sports and exercises, which makes finding an exercise you like easier. There is a good explanation of why exercising is important for both short-term and long-term health.

- Lombardo, M. *OrganWise Guys: Learning to Be Smart from the Inside Out.* Atlanta, GA: Wellness, Inc., 1996.
  The OrganWise Guys educate children in the importance of eating right so they will live a longer, healthier life. Cartoon characters represent each organ inside the body. Each OrganWise Guy describes what the organ's function is and what it needs to keep in tip-top shape. These nutritional issues are addressed: eating low-fat, high-fiber foods; drinking plenty of water; and engaging in regular exercise.

- Tecco, B. D. *Food for Fuel*. New York: Rosen Publishing Group, 2005.
  This book is part of the Library for Nutrition series. Other books in the series include: Food Labels by Rose McCarthy, Food Pyramid and Basic Nutrition by Graham Faiella, and Nutrition Sense by Linda Bickerstaff. All of these books contain fewer than 50 pages.

Web Sites

- http://www.cdc.gov/physicalactivity/everyone/measuring/heartrate.html
  A Center for Disease Control site (CDC) discusses formulas for finding target heart rate and maximum heart rates for moderate-intensity physical activity and vigorous-intensity physical activity. There is also a section with a photograph of taking your pulse at the wrist.

- http://www.cdc.gov/physicalactivity/everyone/measuring/index.html
  On this site the CDC lists what activities are represented as light intensity, moderate intensity, and vigorous intensity. For example, walking slowly is light, walking briskly is moderate, and jogging or running is vigorous. It also discusses the amount of time that should be spent on each level, from 60 minutes for light to 20–30 minutes for vigorous.

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Math and Personal Fitness:

Books and Web Sites (continued)

- http://www.choosemyplate.gov/
  The U.S. Department of Agriculture Web site home page It lists popular topics, links for consumers, and for professionals. It is a great site to allow students to explore and find areas of interest.

- http://www.calorieking.com/foods/
  This site lists fourteen "popular brands" such as McDonald's, Subway, etc. and too many food categories to count. Suppose you have a question about the calories in chicken and poultry—you will be given six poultry choices. If you choose chicken, you will have pages and pages of choices (including every company that sells chicken products). Overwhelming!

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