



West Roxbury Academy
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June 24, 2016

To: West Roxbury Academy parents
Subject: 'Summer Slide' Prevention Effort

Enclosed is the summer academic work for West Roxbury Academy students. Students are being provided English, Mathematics and science assignments to prepare them for the upcoming school year and to prevent loss of learning which can occur over the summer. Directions for how to complete the work is enclosed.

We believe that learning is a yearlong process and that spending time engaged in an intellectual pursuit can better provide students with a better start to the new school year.

Students are to complete the packet and to turn it into their English, Mathematics and Science teachers in September. A completed packet of work is worth two quiz grades. This added benefit is the first step towards a great school year.

Enjoy your summer.

Sincerely,

Rudolph Weekes
Headmaster

GRADE 9

SUMMER

WORK

**ELA – 9TH GRADE
SUMMER
WORK**

Ninth Grade English Language Arts Summer Work

1. You have one sheet for recording the minutes you spend reading each day. Please make your own personal goal with your family to decide how many minutes you plan to read each day-shoot for 20-30.
2. Record your minutes in the appropriate box as well as any new words and inferences (predictions) you might have.
3. Total all of your minutes at the end of each week. At the end of the summer, you will be able to add together each week's minutes for the total amount of minutes spent reading this summer.
4. When we return to school, we will add every participant's (freshmen) together to reach our goal of 140,000-150,000 minutes (be sure to keep your recording sheets in a safe place and return them to me in the fall).
5. If we reach our freshmen goal, there will be a pizza party for all 9th graders.

Required Summer Reading: Please select one of the following books.

Title	Author
Things Fall Apart	Chinua Achebe
Omnivore's Dilemma	Michael Pollan
We Grow Accustomed to the Dark	E. Dickenson
Breath, Eyes, Memory	Edwige Danticat
To Kill A Mockingbird	Harper Lee
Fahrenheit 451	Ray Bradbury
Of Mice and Men	John Steinbeck

Close Guided Reading Questions on _____ (book you chose to read)

These may be answered in you Reader's Notebook, on loose leaf, or typed.

In many books, things are often left unsaid. Write a letter from one character to another in which the writer reveals or confesses something that in the book is left unsaid.

1. Find a significant passage and show specifically how that passage helps a reader understand the whole book.
2. Choose a scene you consider to be a turning point in the book and write about the elements of the scene that you consider significant.
3. Design a new book jacket, including a summary of the book you read and information about the author as well as answer the close guided reading questions in this packet.

West Roxbury Academy Freshmen Read – A-Thon Challenge 2016

My Goal: _____minutes/day

Record how many minutes you read each day of the summer.

Weeks	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.	Sun.	Total	Words/Inferences
Week 1									
Week 2									
Week 3									
Week 4									
Week 5									
Week 6									
Week 7									
Week 8									
Week 9									
Week 10									

Total number of minutes for the summer:

MATH – 9TH GRADE
SUMMER
WORK

West Roxbury Academy Summer Math Packet

Prepared for 8th graders going into 9th, and 9th graders going into the 10th grade

Name: _____

Date: _____

Class: _____

Objective: I CAN... Write an equation in slope intercept form and graph the line using slope intercept form.

Slope – Intercept Form: _____ ; $m =$ _____ ; $b =$ _____

Write the equations in slope intercept form. Then identify the slope and the y-intercept.

1. _____

2. _____

3. _____

Slope: _____

Slope: _____

Slope: _____

y-int: _____

y-int: _____

y-int: _____

STEPS TO GRAPH A LINE WHEN IN SLOPE INTERCEPT FORM:

1. Plot the _____ on the y-axis.
2. From the y-intercept, use the slope = _____ to plot other points.
3. _____ the line through the points.

Identify the slope and y-intercept of the equation, then graph the line.

4. _____

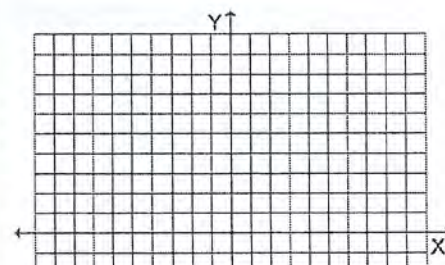
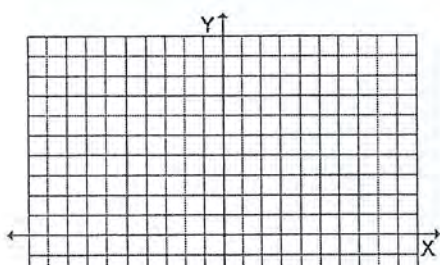
Slope: _____

5. _____

Slope: _____

y-int: _____

y-int: _____

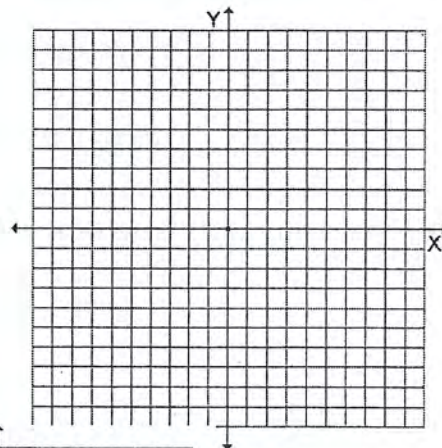
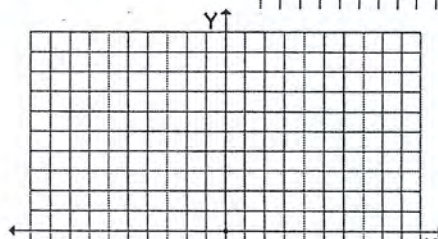
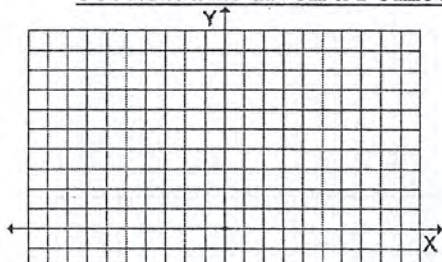


STEPS TO GRAPH A LINE WHEN IN SLOPE INTERCEPT FORM:

1. Plot the **y-intercept** on the y-axis.
 2. From the y-intercept, use the slope = to plot other points.
 3. **Graph** the line through the points.
- a. *Write the equation in slope intercept form.*
b. *Identify the slope and y-intercept.*
c. *Graph the line.*
6. Slope: _____ y-int: _____

7. Slope: _____ y-int: _____

Section 4.2: Given a Point and Slope



OBJECTIVE: I CAN... Write an equation in slope intercept form given the slope and a point on the line.

If a line has a _____ (***m***) and the _____ (***0,b***), then the line can be written in

slope intercept form: _____

Write the equation of the line in slope-intercept form given the information below.

1. Slope: ; y-Intercept: (0, -4)
2. $m = 4$ and $b: (0, -3)$
3. Write an equation of a line with an x-coefficient of -3 and a y-intercept of 7.
4. Write an equation with a slope of 2 and a constant of -5.

Writing an equation given the SLOPE and a POINT:

1. Write $y = mx + b$
2. Substitute in the slope (***m***) and the point (***x, y***)
3. Solve for the y-intercept (***b***)
4. Substitute only the slope (***m***) and the y-intercept (***b***) into slope-int form: $y = mx + b$

Write an equation of a line given the slope and a point:

5. _____

6. _____

Writing an equation given the SLOPE and a POINT:

1. Write $y = mx + b$
2. Substitute in the slope (***m***) and the point (***x, y***)
3. Solve for the y-intercept (***b***)
4. Substitute only the slope (***m***) and the y-intercept (***b***) into slope-int form: $y = mx + b$

Write an equation of a line given the slope and a point:

7. _____

8. _____

Writing an equation from a GRAPH given the y-intercept:

1. **y-intercept (b)** : Where does the line cross the y-axis?
2. **Slope (m)** : Use $m =$
3. Substitute only (m) and (b) into slope-intercept form: $y = mx + b$

9.

10.

Section 4.3: Writing an Equation Given 2 Points

OBJECTIVE: *I CAN ... Write an equation in slope intercept form given two points on the line.*

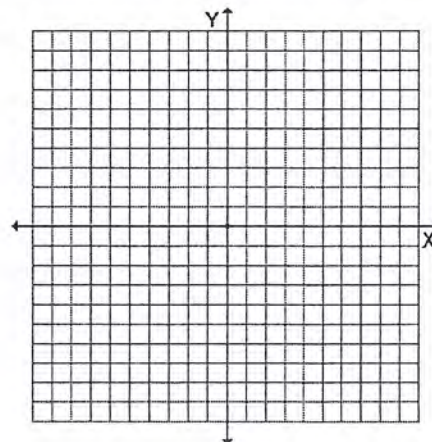
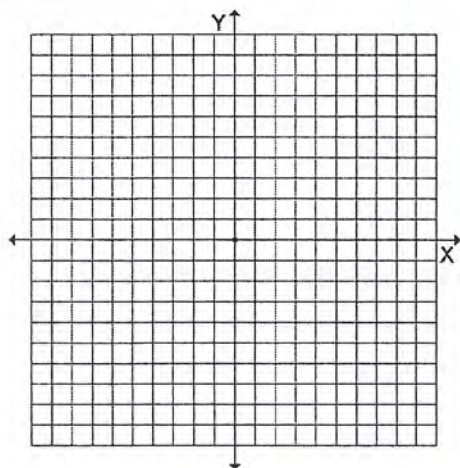
Steps to writing the equation given TWO POINTS:

1. Find the slope:
2. Substitute the slope (m) and one point (x, y) into slope-intercept form: $y = mx + b$
3. Solve for the y-intercept (b)
4. Substitute only the slope (m) and the y-intercept (b) into slope-intercept form: $y = mx + b$

Write the equation of the line given the two points.

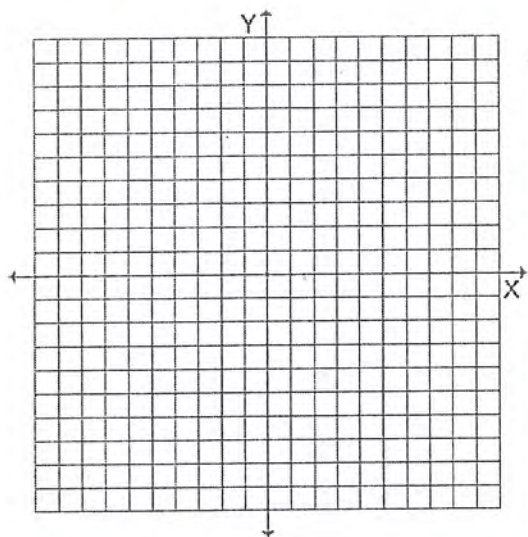
1. $(-5, 7)$ and $(2, -7)$

2. $(2, 0)$ and $(-2, 6)$

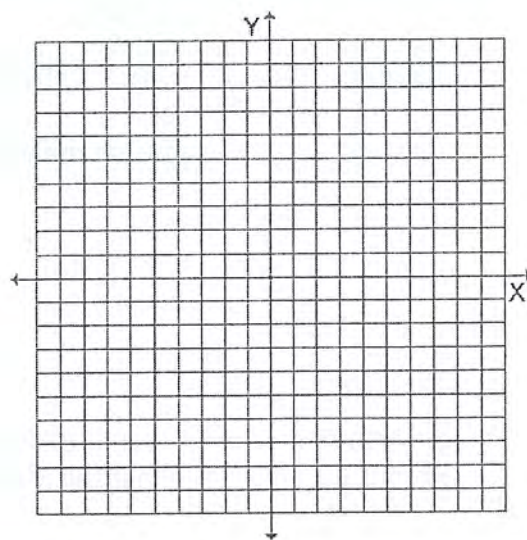


Write the equation of the line given the two points.

3. $(2, -3)$ and $(-3, 7)$



4. $(1, 1)$ and $(7, 4)$



"BOX" METHOD FOR MULTIPLYING BINOMIALS

Multiplying two binomials is very much like finding the area of a rectangle with those binomials as dimensions. The box method for multiplication can be helpful in understanding this concept.

Example: To multiply $(x + 3)$ by $(x + 2)$,

First set the dimensions on the box:

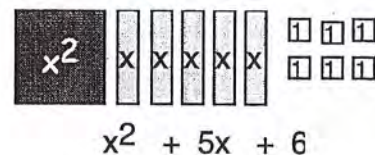
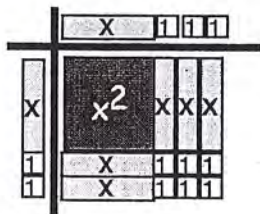
	x	$+$	3
x			
$+$			
2			

Next, find the area of each individual rectangle
From this, we can see that the area is:

$$A = x^2 + 3x + 2x + 6$$

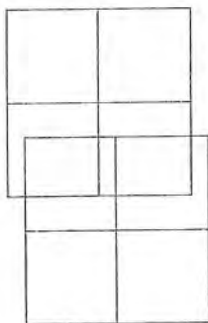
Combining like terms, we get: $A = x^2 + 5x + 6$

This can be verified using Algebra Tiles:



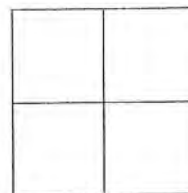
***Now try these:**

1. $(x + 8)$ by $(x + 2)$



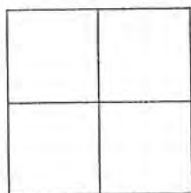
Area: _____

2. $(x + 5)$ by $(x + 6)$



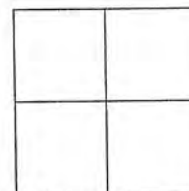
Area: _____

3. $(x + 3)$ by $(x - 4)$
(Be Careful!)

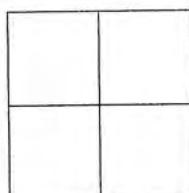


Area: _____

4. $(x - 5)$ by $(x + 1)$

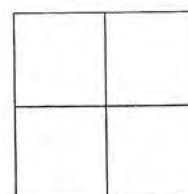


5. $(x + 5)$ by $(x + 6)$



Area: _____

6. $(2x + 1)$ by $(x + 7)$
(Be Careful!)

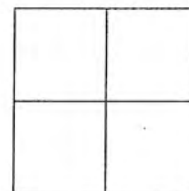


Area: _____

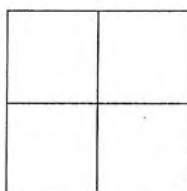
7. $(x + 7)$ by $(x + 5)$

8. Area: _____
 $(2x + 2)$ by $(x + 3)$

Area: _____

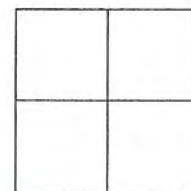


9. $(x + 8)$ by $(x + 9)$



10. Area: _____
 $(2x - 4)$ by $(x + 5)$

Area: _____



11. State how you can find what the first and last terms of the quadratic expression are given the two factors?

12. State how you can find what middle term of the quadratic expression is given the two factors? _____

13. Use your answers in # 11 and # 12 to multiply:

a) $(x + 13)(x - 7)$ _____

b) $(3x - 5)(x + 3)$ _____

c) $(3x + 1)(7x - 8)$ _____

Multiplying Binomials FOIL Practice Worksheet

Find Each Product.

1. $(x + 1)(x + 1)$

2. $(x + 1)(x + 2)$

4. $(x + 3)(x + 2)$

6. $(x - 6)(x + 2)$

8. $(y + 6)(y + 5)$

10. $(y + 6)(3y + 2)$

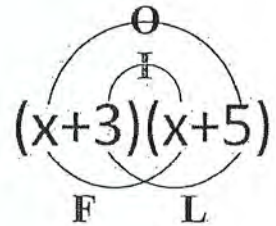
3. $(x + 2)(x + 3)$

5. $(x + 4)(x + 3)$

7. $(x - 5)(x - 4)$

9. $(2x + 1)(x + 2)$

11. $(2x + 1)(2x + 1)$



Multiplying Binomials Cont...

12. $(x + 5)(3x - 1)$

13. $(2x - 1)(x - 3)$

14. $(x + y)(x + y)$

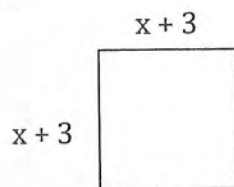
15. $(3x + y)(x + y)$

16. $(2x + y)(2x - y)$

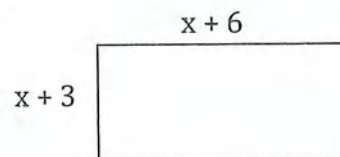
17. $(3x - y)(x + 2y)$

Find the area of each shape.

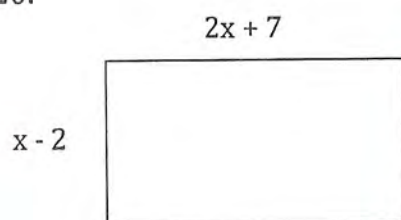
18.



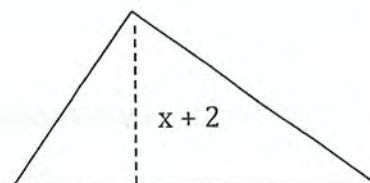
19.



20.



21.



Polynomials & Factoring

Part I: Multiple Choice (4 points each)

Directions: Use your knowledge of factoring to answer the following questions below.

___ 1) Which of the following expressions is a **trinomial**?

- | | |
|-----|----------------------|
| (1) | (3) $+ 2y^2 + y - 4$ |
| (2) | (4) |

___ 2) Which of the following expressions is a **binomial**?

- | | |
|-----|----------------------|
| (1) | (3) $+ 2y^2 + y - 4$ |
| (2) | (4) |

___ 3) Expressed in factored form, the binomial is equivalent to:

- | | |
|-----|-----|
| (1) | (3) |
| (2) | (4) |

___ 4) What is the GCF of ?

- | | |
|----------|-----------|
| (1) 9 | (3) $9xy$ |
| (2) xy | (4) $6xy$ |

___ 5) One of the factors of is:

- | | |
|-------------|--------------|
| (1) $x + 4$ | (3) $2x$ |
| (2) $x - 8$ | (4) $2x - 8$ |

___ 6) A common factor of and is:

- | | |
|-------------|-------------|
| (1) $x - 5$ | (3) $x + 2$ |
| (2) $x + 5$ | (4) x^2 |

___ 7) One of the factors of $25x^2 - 9$ is $5x - 3$. Find the other factor.

- | | |
|-----------------|--------------|
| (1) $25x^2 - 9$ | (3) $5x - 3$ |
| (2) $5x + 3$ | (4) x^2 |

Part II: Factoring (4 points each)

Directions: Factor each expression below completely. Show ALL Work!

8) $196 - 4y^2$	9) $2ax - 5x$	10) $24a^2b + 18abc$
11) $4x^2 - 24x - 28$	12) $49m^2 - 100n^2$	13) $20 + 9x + x^2$
14) $x^4 - 1$	15) $6x^2 - 6y^2$	16) $2x^3 - 8x$
17) $5x^2 + 20x + 20$	18) $5x^3 - 10x^2 - 15x$	19) $x^2 - x - 56$

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Part III: Multiply or divide each of the following expressions. (4 points each)

20) $(d - 5)^2$	21) $(10x - 1)(x + 7)$
22)	
23)	
24)	
25)	

Open Response Question:

Adding, Subtracting and
Multiplying Polynomials

Janet wants to fill a rectangular garden with flowers. She does not know exactly how long the sides of the garden are but she knows that the width of the garden is x feet and the length of the garden is $2x + 3$ feet.

- Draw a diagram of the garden labeling the dimensions.
- Write a simplified polynomial expression showing the Perimeter of the garden.
- Write a simplified polynomial expression showing the Area of the garden.
- If $x = 8$, and Janet wants to put up a fence around the garden how long will the fence be?

VOCABULARY	RESPONSE/ANSWER/COMMENTS/REMARKS
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Use the following polynomial to answer the questions that follow: How do you classify the polynomial above? What is the degree and leading coefficient?	Fill in the blank: 1 term = _____ _____ = binomial 4 or more terms = _____
ADDING AND SUBTRACTING	Add and/or subtract the following polynomials by combining like terms.
MULTIPLYING: Use a separate sheet of paper for all the work.	Multiply the following polynomials together using any method.
	ANSWERS ON THIS SIDE ONLY

West Roxbury Academy Claim Evidence and Reasoning Question

Claim – (What do you know) A claim is a statement of a student’s understanding about a phenomenon or about the results of an investigation; it answers the original question by expressing what he or she is trying to help an audience understand and believe.

Evidence – (How do I know this the solution)

Reasoning – (Does the solution make sense)

Question:

A square has an unknown length and width. If its length is increased by 11 units to create a new, larger rectangle, write a simplified algebraic expression for the area of the new rectangle in terms of a if a represents the length of the original square.

What is the Question asking?

Claim:

This Claim: ☐ Directly answers the question

Evidence:

This Evidence: ☐ Comes from the Given Information ☐ Can Prove the Claim

Reasoning:

This Reasoning: ☐ Uses a "Linking Word or Phrase" ☐ **Tells how** the Evidence Proves the Claim

Question:

A square has an unknown length and width. If its length is increased by 11 units to create a new, larger rectangle, write a simplified algebraic expression for the area of the new rectangle in terms of a if a represents the length of the original square.

One-Step Equations

Solve each equation.

1) $26 = 8 + v$

2) $3 + p = 8$

3) $15 + b = 23$

4) $-15 + n = -9$

5) $m + 4 = -12$

6) $x - 7 = 13$

7) $m - 9 = -13$

8) $p - 6 = -5$

9) $v - 15 = -27$

10) $n + 16 = 9$

11) $-104 = 8x$

12) $14b = -56$

13) $-6 = \frac{b}{18}$

14) $10n = 40$

$$15) \frac{v}{8} = 2$$

$$16) 16 = \frac{k}{11}$$

$$17) -15x = 0$$

$$18) -17x = -204$$

$$19) 21 = -7n$$

$$20) \frac{m}{4} = -13$$

$$21) -126 = 14k$$

$$22) -143 = -11x$$

$$23) -16 + x = -15$$

$$24) -5 = \frac{a}{18}$$

$$25) -17 = x - 15$$

$$26) n - 8 = -10$$

$$27) \frac{v}{7} = 8$$

$$28) a + 11 = 20$$

$$29) -7 + m = 8$$

$$30) 18 + m = 8$$

Two-Step Equations

Date _____ Period _____

Solve each equation.

1) $6 = \frac{a}{4} + 2$

2) $-6 + \frac{x}{4} = -5$

3) $9x - 7 = -7$

4) $0 = 4 + \frac{n}{5}$

5) $-4 = \frac{r}{20} - 5$

6) $-1 = \frac{5+x}{6}$

7) $\frac{v+9}{3} = 8$

8) $2(n+5) = -2$

9) $-9x + 1 = -80$

10) $-6 = \frac{n}{2} - 10$

11) $-2 = 2 + \frac{v}{4}$

12) $144 = -12(x+5)$

$$13) -15 = -4m + 5$$

$$14) 10 - 6v = -104$$

$$15) 8n + 7 = 31$$

$$16) -9x - 13 = -103$$

$$17) \frac{n+5}{-16} = -1$$

$$18) -10 = -10 + 7m$$

$$19) -10 = 10(k - 9)$$

$$20) \frac{m}{9} - 1 = -2$$

$$21) 9 + 9n = 9$$

$$22) 7(9 + k) = 84$$

$$23) 8 + \frac{b}{-4} = 5$$

$$24) -243 = -9(10 + x)$$

NAME _____

DATE _____

PERIOD _____

5-2 Practice*Rational Numbers*

Write each number as a fraction.

1. 29

2. 0

3. $3\frac{7}{8}$

4. -47

5. $-5\frac{6}{7}$

6. $4\frac{3}{20}$

7. $-7\frac{2}{15}$

8. $10\frac{2}{9}$

Write each decimal as a fraction or mixed number in simplest form.

9. 0.32

10. 0.42

11. $0.\overline{8}$

12. $-6.\overline{3}$

13. 0.91

14. 17.875

15. $-0.666\ldots$

16. 0.07

17. $9.\overline{7}$

18. 7.75

19. 0.525

20. -8.26

21. $6.\overline{5}$

22. -4.12

23. 13.006

24. $3.\overline{34}$

Identify all sets to which each number belongs (W = whole numbers, I = integers, Q = rational numbers).

25. 15

26. $-3.\overline{8}$

27. -5.075

28. $\frac{50}{25}$

29. π

30. $-\frac{4}{2}$

31. **BOTANY** The smallest flowering plant is the flowering aquatic duckweed found in Australia. It is 0.0236 inch long and 0.0129 inch wide. Write these dimensions as fractions in simplest form.

5-3**Practice****Multiplying Rational Numbers**

Find each product. Write in simplest form.

1. $\frac{3}{4} \cdot \frac{2}{3}$

2. $\frac{3}{7} \cdot \frac{21}{39}$

3. $-\frac{3}{4} \cdot \frac{10}{27}$

4. $\frac{11}{14} \cdot \frac{7}{33}$

5. $-\frac{18}{24} \cdot \frac{3}{4}$

6. $\frac{9}{10} \cdot \frac{20}{21}$

7. $-50 \cdot \frac{3}{1000}$

8. $\frac{13}{17} \cdot \left(-\frac{5}{8}\right)$

9. $-\frac{1}{2} \cdot \left(-\frac{20}{27}\right)$

10. $-\frac{14}{15} \cdot \left(-\frac{10}{28}\right)$

11. $4\frac{4}{7} \cdot 9\frac{1}{3}$

12. $-2\frac{14}{25} \cdot 4\frac{3}{8}$

13. $4\frac{1}{8} \cdot \left(-1\frac{5}{11}\right)$

14. $-5 \cdot \frac{17}{25}$

15. $2\frac{9}{10} \cdot 1\frac{1}{5}$

16. $\frac{6m}{13} \cdot \frac{2}{mn}$

17. $\frac{p}{3} \cdot \frac{1}{q}$

18. $\frac{2u}{v^2} \cdot \frac{3}{u}$

19. $\frac{4x}{3y} \cdot \frac{9y}{2x}$

20. $\frac{2a}{b} \cdot \frac{c}{2d}$

21. $\frac{rs}{9t} \cdot \frac{3}{s^2}$

22. $2x \cdot \frac{1}{4x^2}$

23. $\frac{x^2}{4y} \cdot \frac{16y^2}{3x}$

24. $\frac{2}{r} \cdot \frac{3}{r}$

25. **WEIGHTS** How many ounces are in $3\frac{3}{4}$ pounds?

26. **FOOTBALL** The total length of 17.6 football fields equals 1 mile. How long is a mile?
(Hint: length of a football field = 100 yd)

27. **AIRPLANES** The fastest airliner, the Concorde, has the capability of cruising at speeds of up to 1450 mph. While cruising at this top speed, how far would the Concorde travel in $2\frac{1}{2}$ hours?

5-4 Practice*Dividing Rational Numbers*

Find each quotient. Write in simplest form.

1. $\frac{1}{2} \div \frac{1}{10}$

2. $-\frac{3}{8} \div \frac{9}{24}$

3. $-\frac{15}{16} \div \frac{7}{12}$

4. $\frac{17}{20} \div \left(-\frac{3}{10}\right)$

5. $-\frac{3}{8} \div \left(-\frac{3}{9}\right)$

6. $\frac{25}{32} \div \frac{15}{56}$

7. $0 \div \frac{17}{18}$

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

9. $\frac{8}{9} \div \frac{22}{81}$

10. $8\frac{4}{9} \div 2\frac{1}{9}$

11. $4\frac{3}{5} \div \frac{2}{5}$

12. $-\frac{100}{63} \div \frac{10}{81}$

13. $18\frac{1}{3} \div \left(-4\frac{1}{6}\right)$

14. $-3\frac{2}{9} \div \frac{4}{27}$

15. $-2\frac{5}{6} \div \frac{3}{51}$

16. $4\frac{11}{12} \div 4\frac{5}{6}$

17. $\frac{2x}{3} \div \frac{1}{9}$

18. $\frac{a}{4} \div \frac{a}{8}$

19. $\frac{4k}{5} \div \frac{25}{2k}$

20. $\frac{ab}{8} \div \frac{b}{a}$

21. $\frac{2c}{b} \div \frac{4a}{b}$

22. $\frac{y}{x} \div y^2$

23. $\frac{3st}{r} \div \frac{4t}{r}$

24. $\frac{a^2}{b^2} \div \frac{c^2}{b^2}$

25. $-\frac{2x}{y} \div \frac{4}{y}$

26. $\frac{m^2}{2np} \div \frac{n}{4p}$

27. Evaluate $x \div y$ if $x = 3\frac{1}{2}$ and $y = \frac{3}{4}$.

28. Evaluate $w \div z$ if $w = \frac{6}{7}$ and $z = 3$.

29. **TRAVEL** What is the average speed that Robin must drive to reach her friend's house 170 miles away in $2\frac{1}{2}$ hours?

30. **SEWING** How many choir robes can be made from $20\frac{1}{4}$ yards of fabric if each robe needs $1\frac{1}{8}$ yards?

5-5**Practice*****Adding and Subtracting Like Fractions***

Find each sum or difference. Write in simplest form.

1. $\frac{5}{7} + \frac{2}{7}$

2. $\frac{5}{11} - \frac{1}{11}$

3. $\frac{13}{20} - \frac{3}{20}$

4. $\frac{5}{16} + \frac{15}{16}$

5. $-\frac{19}{40} + \frac{21}{40}$

6. $\frac{7}{9} - \frac{4}{9}$

7. $\frac{14}{23} - \frac{16}{23}$

8. $\frac{25}{36} + \left(-\frac{7}{36}\right)$

9. $\frac{21}{25} + \frac{9}{25}$

10. $10\frac{4}{7} + 11\frac{5}{7}$

11. $9\frac{3}{8} + 4\frac{1}{8}$

12. $-8\frac{7}{10} + 2\frac{3}{10}$

13. $23\frac{17}{20} - 4\frac{7}{20}$

14. $22\frac{3}{8} - 18\frac{5}{8}$

15. $7\frac{9}{10} + 3\frac{3}{10}$

16. $6\frac{1}{6} - 3\frac{5}{6}$

17. $5\frac{1}{4} + 3\frac{1}{4} + 9\frac{3}{4}$

18. $6\frac{7}{8} + \left(-7\frac{3}{8}\right)$

19. $\frac{h}{6} + \frac{4h}{6}$

20. $\frac{5c}{22} + \frac{5c}{22}$

21. $\frac{35}{d} - \frac{17}{d}, d \neq 0$

22. $\frac{4r}{9} + \frac{5r}{9}$

23. $\frac{6s}{t} + \frac{s}{t}$

24. $\frac{5p}{9} - \frac{4p}{9}$

25. $\frac{6r^2}{s^2} + \frac{5r^2}{s^2}$

26. $4\frac{5}{7a} - 2\frac{3}{7a}$

27. **PICTURE FRAMING** Matt plans to paste a picture that is $6\frac{7}{8}$ inches wide on a sheet of paper that is $8\frac{4}{8}$ inches wide. If he wants to have at least $\frac{5}{8}$ inch of margin on each side, will the picture fit? Explain.

5-6 Practice**Least Common Multiple**

Find the least common multiple (LCM) of each pair of numbers or monomials.

1. 10, 12

2. 9, 15

3. 20, 24

4. 30, 45

5. 14, 15

6. 35, 75

7. 12, 63

8. 48, 20

9. $15q$, $3q^2t$

10. 9, $18b$

11. $8y$, $10y^2$

12. $20p$, $100p^2$

Find the least common denominator (LCD) of each pair of fractions.

13. $\frac{1}{2}$, $\frac{2}{3}$

14. $\frac{9}{14}$, $\frac{3}{7}$

15. $\frac{5}{12}$, $\frac{8}{15}$

16. $\frac{13}{18}$, $\frac{6}{45}$

17. $\frac{5}{32}$, $\frac{17}{24}$

18. $\frac{1}{x}$, $\frac{3}{xy}$

19. $\frac{3}{8m}$, $\frac{1}{4mn^2}$

20. $\frac{12}{25ab}$, $\frac{3}{100b^2}$

Replace each with $<$, $>$, or $=$ to make a true sentence.

21. $\frac{2}{5}$, $\frac{7}{15}$

22. $\frac{4}{9}$, $\frac{8}{18}$

23. $\frac{9}{36}$, $\frac{4}{8}$

24. $\frac{4}{8}$, $\frac{5}{9}$

25. $\frac{4}{18}$, $\frac{3}{15}$

26. $\frac{3}{28}$, $\frac{5}{32}$

27. **VOTING** During a student council meeting, $\frac{7}{12}$ of the members voted to hold a bake sale.

If a $\frac{2}{3}$ vote is required to pass, will a bake sale be held?

5-7**Practice*****Adding and Subtracting Unlike Fractions***

Find each sum or difference. Write in simplest form.

1. $\frac{9}{10} + \frac{1}{2}$

2. $\frac{7}{8} + \frac{1}{10}$

3. $-\frac{3}{4} \div \frac{5}{16}$

4. $\frac{4}{5} - \frac{2}{6}$

5. $\frac{5}{8} - \frac{3}{16}$

6. $\frac{1}{3} + \frac{5}{36}$

7. $\frac{7}{10} - \frac{14}{100}$

8. $\frac{17}{21} - \frac{4}{6}$

9. $\frac{11}{14} - \frac{1}{6}$

10. $\frac{4}{15} - \left(-\frac{3}{12}\right)$

11. $\frac{7}{15} + \frac{3}{6}$

12. $-\frac{7}{8} + \frac{9}{10}$

13. $10\frac{1}{2} + 7\frac{1}{3}$

14. $7\frac{1}{2} - 2\frac{7}{10}$

15. $8\frac{1}{6} + 5\frac{3}{4}$

16. $7\frac{7}{12} - 5\frac{1}{3}$

17. $6\frac{4}{5} + \left(-2\frac{3}{8}\right)$

18. $16\frac{3}{5} + 3\frac{11}{15}$

19. $18\frac{3}{5} - 7\frac{1}{4}$

20. $12\frac{2}{7} - 3\frac{5}{6}$

21. $2\frac{5}{8} + 6\frac{3}{4}$

22. $29\frac{8}{33} + \left(-3\frac{1}{3}\right)$

23. $-6\frac{2}{7} - 5\frac{3}{14}$

24. $-16\frac{2}{7} - 3\frac{20}{21}$

25. $-10\frac{1}{9} + 9\frac{7}{45}$

26. $\frac{1}{3} + \frac{5}{6} + \frac{1}{2}$

27. $9\frac{2}{7} - 11\frac{18}{21}$

28. $-17\frac{2}{3} - \left(-5\frac{4}{18}\right)$

29. $11\frac{3}{16} - 5\frac{1}{12}$

30. $\frac{64}{143} - \frac{21}{208}$

31. **SEWING** The inseam on Juan's pants is $34\frac{1}{4}$ inches. If he has them shortened by $2\frac{7}{8}$ inches, what is the new length?

NAME _____

DATE _____

PERIOD _____

5-8**Practice***Solving Equations With Rational Numbers*

Solve each equation. Check your solution.

1. $y + 6.1 = 19.5$

2. $m + 5.8 = 19.9$

3. $8.7 + x = 9.6$

4. $t - 4.82 = 5.36$

5. $\frac{1}{2} + x = \frac{4}{7}$

6. $-11 = x - 8$

7. $\frac{11}{12} = \frac{3}{8} + v$

8. $-2.9 = m - 3.6$

9. $\frac{x}{5.09} = 0$

10. $6 = \frac{3}{7} + u$

11. $\frac{4}{5}x = \frac{16}{25}$

12. $\frac{q}{3.2} = -20$

13. $9\frac{3}{4} = r - 6\frac{2}{9}$

14. $\frac{14}{25} = v + \frac{1}{2}$

15. $0.8p = 6$

16. $y + 2\frac{2}{5} = 5\frac{4}{15}$

17. $10 = \frac{5}{9}u$

18. $6\frac{2}{3} = n - 10\frac{1}{9}$

19. $b - \frac{7}{10} = -\frac{1}{4}$

20. $-5.2 = 20.8c$

21. $\frac{3}{8} + g = \frac{7}{12}$

22. $3\frac{3}{4} + h = -8\frac{1}{2}$

23. $9 = -\frac{1}{4}w$

24. $1\frac{1}{2} = 6q$

25. **ELECTRICITY** If a television uses $\frac{3}{20}$ kilowatt-hours of electricity per hour, how long will it take to use 14 kilowatt-hours of electricity?

26. **COMPUTER DISKS** Mr. Rosenthal bought 15 computer disks and a carrying case for \$28.50. If the carrying case cost \$6.75, what was the cost of each disk?

8-2**Practice*****Solving Equations with Grouping Symbols***

Solve each equation. Check your solution.

1. $4(j - 7) = 12$

2. $5(2k + 10) = 40$

3. $7(2p + 3) - 8 = 6p + 29$

4. $7(g - 4) = 3$

5. $3(4c + 5) = 24$

6. $2(a - 1) = 3(a + 1)$

7. $3(x - 3) = 5(1.5 + x)$

8. $2(1.5m + 3) = 3.5m - 1$

9. $a - \frac{5}{10} = 2a - \frac{3}{5}$

10. $2.2x - 5 = 2(1.4x + 3)$

11. $\frac{d}{0.2} = 3d + 2.1$

12. $5n + 3 = 2(n + 2) - 3n$

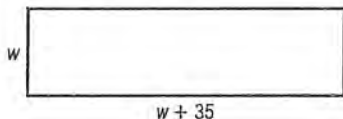
13. $\frac{2}{3}a + 2 = \frac{1}{3}(4a + 1)$

14. $y - 7 = \frac{1}{4}(y + 2)$

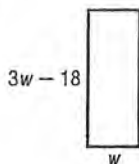
15. $5(f + 2) = 9 + 5f$

Find the dimensions of each rectangle. The perimeter is given.

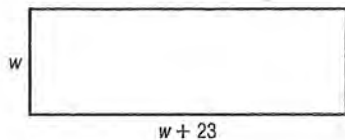
16. $P = 122$ m



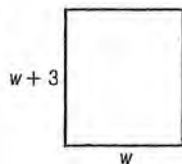
17. $P = 244$ yd



18. $P = 698$ cm



19. $P = 86$ in.



20. **GEOMETRY** The perimeter of a rectangle is 80 feet. Find the dimensions if the length is 5 feet longer than four times the width. Then find the area of the rectangle.

21. **NUMBER THEORY** Five times the sum of three consecutive integers is 150. What are the integers?

PHYSICS
SUMMER
WORK

Instructions

For the following pages, read each chapter and take notes on a separate piece of paper. On the same paper, answer all of the questions at the end of each chapter

1-1 What is physical science?

Objective

Identify and describe the main branches of physical science.

Key Terms

chemistry: branch of science that deals with the study of the structure and the makeup of matter and the changes matter undergoes

physics: branch of science that deals with energy and matter and how they interact

specialization (spehsh-uh-lih-ZAY-shuhn): studying or working in one area of a subject

Studying Physical Science Physical science is one of the major fields of science. It is the study of matter and energy. Everything around you is either matter or energy.

Physical science has two main branches. The two main branches are chemistry and physics. Chemistry deals with the study of the structure and the makeup of matter and the changes matter undergoes. Physics deals with the study of energy and matter and how they interact.

▶ **NAME:** What are the two main branches of physical science?

Specialization A specialist is a person who studies or works in one particular area of a subject. Working in one area of a subject is called specialization. Some of the specialized fields of physical science are listed in Figure 1-2.

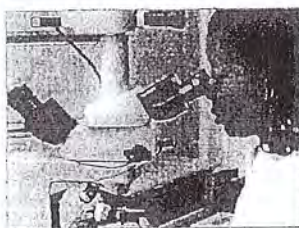
▶ **DEFINE:** What is a specialist?

Importance of Physical Science Why study physical science? Physical science is an important part of everyday life. It is difficult to think of anything that does not involve physical science. The discoveries of physical scientists. For example, each year seat belts save thousands of lives. Seat belt technology is based on the laws of motion.

Physical scientists have also discovered how to harness nuclear energy. Using nuclear energy has both problems and benefits. Physical scientists are constantly working to solve the problems related to nuclear energy. Their solutions may someday solve the world's energy problems. Physicists are also researching other forms of energy for power. Solar panels, wind farms, fuel cells are some alternative sources of energy.

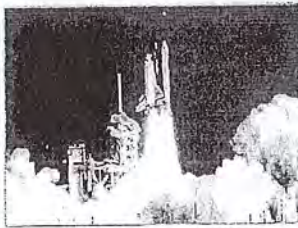
The discovery of new materials has resulted in the production of a variety of ceramic tiles, various glass products, and plastics. Our leisure time has benefited through cable and satellite dish TV, la-

SOME SPECIALIZED FIELDS IN PHYSICAL SCIENCE



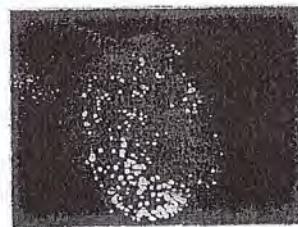
Biochemistry

Biochemists study the chemical substances occurring in living things. Some careers in biochemistry include medical research, plant and animal genetics, and pharmaceuticals.



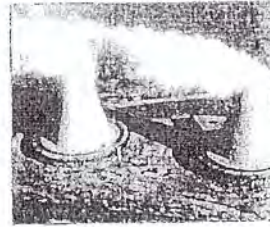
Thermodynamics

Thermodynamics deals with heat and its conversion to other forms of energy. Research and engineering are two careers to pursue if you are interested in the study of thermodynamics.



Optics

Optics is the science of light and vision. Some careers in the field of optics include optician and research scientist in such areas as lasers and optical fibers.



Nuclear Physics

Nuclear physicists study the characteristics, behavior, and structure of atomic nuclei. Careers include research, reactor manufacturing, and power plant operation.

▶ Figure 1-2

computers, holograms, and CD and DVD players. Cars and airplanes have been made safer and faster.

Studying matter and how it reacts with other substances has helped create all of these things. We will take a closer look at reactions and interactions of matter and energy as we progress through the book.

▶ **LIST:** What are some of the products that have been created because of the work of physical scientists?

✓ CHECKING CONCEPTS

1. The two main branches of physical science are chemistry and _____.
2. Physical science is the study of matter and _____.
3. A person who works in only one area of a subject is a _____.
4. Physical scientists have helped develop ceramics, plastics, and _____.
5. The harnessing of _____ energy by physical scientists has helped reduce the world's energy problems.



People in Science SCIENTIFIC ILLUSTRATOR

Do you like to draw? If so, you may be interested in a career as a scientific illustrator. You can see the work of scientific illustrators on many pages in this book. Scientific illustrators make drawings, diagrams, and sketches to illustrate scientific processes, structures, cycles, or equations, helping people to understand scientific concepts.

Scientific illustrators are employed by publishers of science books and journals or by advertisers. The drawings of scientific illustrators are used in sales brochures, advertisements, and even in this book. In the catalogs of scientific supply houses and pharmaceutical companies, many drawings are used to demonstrate equipment and other supplies.

If you are interested in becoming a scientific illustrator, you need a college degree in graphics or fine arts. Many scientific illustrators also find a background in the sciences helpful in their careers.

Thinking Critically How does the work of a scientific illustrator help people learn science?



THINKING CRITICALLY

6. **ANALYZE:** Why do you think the number of specialized fields in physical science has grown during the past few decades?
7. **LIST:** What are three ways in which physical science is important in your daily life?

Web InfoSearch

A Career in Physical Science If you like science, you may be interested in a career in physical science. Choose a career from Figure 1-2, or a field of science that interests you.

SEARCH: Use the Internet to find out what education is required, what you will do on the job, and what tools you might need to perform this job. Write a short report about your results. Start your search at www.conceptsandchallenges.com. Some key search words are biochemist and nuclear physicist.



▲ Figure 1-3 Scientific illustrators often use computers as tools.

1-2 what are the properties of matter?

INVESTIGATE

Air as Matter HANDS-ON ACTIVITY

1. Stuff a tissue into the bottom of a glass. Fill a pail with water.
2. Turn the glass upside down; push it straight down into the water.
3. Pull the glass straight out of the water and feel the tissue.
4. Record your observations.

THINK ABOUT IT: Did water enter the glass? How do you know? What does this tell you about air?



STEP 2

Objective

Identify two basic properties of matter.

Key Terms

matter: anything that has mass and takes up space

properties (PRAHP-uhr-teez): characteristics used to describe an object

Matter Look around you. What do all the objects you see around you have in common? They are all made up of matter. Matter is anything that has mass and takes up space. Mass is the amount of matter a sample of matter contains. The amount of space the sample takes up is its volume.

Water is matter. A glass filled with water is heavier than an empty glass. The water-filled glass is heavier because water has more mass than the air in the empty container. If you were to keep adding water to a filled glass, the water would overflow. It would overflow because water takes up space, leaving no room in the glass.

Air is matter, too. A balloon filled with air is heavier than a balloon that is not blown up because air has mass. When you blow air into a balloon, the balloon gets larger as air takes up space.

DEFINE: What is matter?

Defining Properties: How would you describe a hot-air balloon? You might say that it is rounded blue, and striped. These are properties of that balloon. Properties are characteristics used to describe an object.

Not all hot-air balloons have the same properties. A different hot-air balloon may be rounded, green, and dotted. Some properties are not basic properties. They do not apply to all examples of the object. A basic property of all hot-air balloons is that they are balloons.

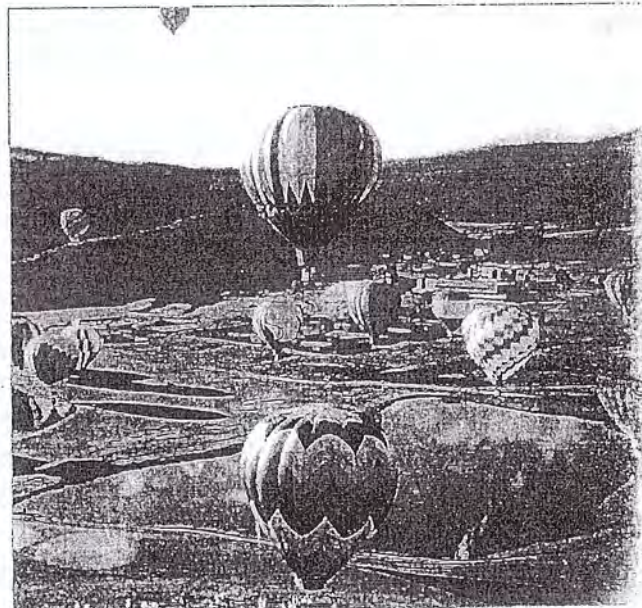


Figure 1-4 Hot-air balloons have properties that describe them.

DEFINE: What is a property?

Properties of Matter Mass and volume are basic properties of all matter. Mass is a measure of the amount of matter in an object. Volume is a measure of how much space matter takes up. Mass is measured in kilograms. Volume is measured in cubic meters. A cubic meter is a cube that is one meter long on each side.

Weight and density are also properties that may be used to describe matter. Weight is a measure of the pull of gravity on a sample of matter. Density tells you how much is in a unit volume.

LIST: What are two basic properties of matter?

CHECKING CONCEPTS

1. All the objects you see around you are made up of _____.
2. Matter is anything that has mass and takes up _____.
3. Mass is a basic _____ of matter.



How Do They Know That?

MASS IS A PROPERTY OF MATTER

Chemists are scientists who study matter. Antoine Lavoisier (1743–1794) was a French chemist. He was educated as a lawyer. However, he loved chemistry. Antoine was helped in his work by his wife Marie Anne. Unlike most women of the day, Marie Anne had received an education in the arts and sciences. This enabled her to work side by side in the lab with her husband.

Before the work of the Lavoisiers, little was known about chemical reactions. For example, it was believed that there were only four elements. People also thought that chemical activities could create mass.

Marie Anne and Antoine showed that these ideas were not true. They explained that mass is not created or lost during a chemical reaction. Before an experiment, Antoine measured all of the materials going into the reaction. After the experiment, he measured the materials produced. He was the first scientist to realize that reactions began and ended with the same amount of mass. He wrote the Law of Conservation of Mass. It states that mass is neither created nor destroyed during a chemical change.

Thinking Critically The burning of wood is a chemical reaction. When wood burns, is mass destroyed?

4. Weight is a measure of the pull of _____ on an object.

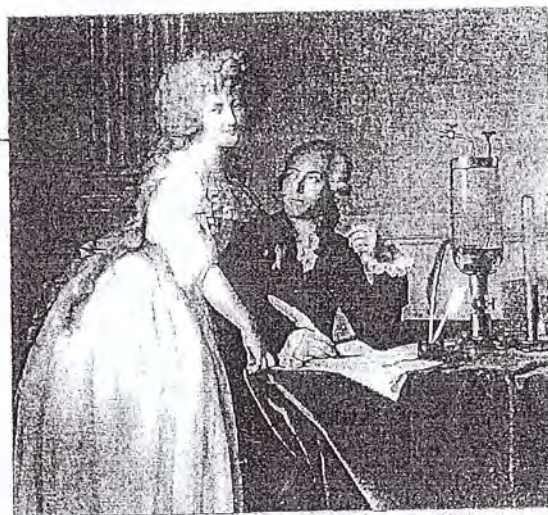
5. The amount of space taken up by matter is its _____.

THINKING CRITICALLY

6. **INFER:** What is the difference between mass and weight?
7. **EXPLAIN:** Why do you think scientists can use the basic properties of matter to help identify an unknown substance?

BUILDING SCIENCE SKILLS

Observing Choose three objects in your home or classroom. Examine each carefully. List four properties of each and the senses you used to help describe each.



▲ Figure 1-5 Marie Anne and Antoine Lavoisier working together

1-3 what are the states of matter?

Objective

Identify and describe four states of matter.

Key Terms

state of matter: any of the four physical forms of matter

solid: state of matter with a definite shape and volume

liquid: state of matter with a definite volume but no definite shape

gas: state of matter that has no definite shape or volume

plasma (PLAZ-muh): state of matter made up of electrically charged particles

States of Matter You cool drinks with solid ice cubes. You wash your hands in liquid water. Water that evaporates from puddles after a rainstorm has changed to a gas called water vapor. Ice, liquid water, and water vapor all are made up of particles of water. Different forms of the same substance are called states. A state of matter is any one of the four physical forms of matter. The three most familiar states of matter are solid, liquid, and gas. A fourth state, plasma, is found mainly in stars like our Sun.

1 IDENTIFY: In how many states can matter exist?

Most of the objects that surround you are made of solids. A solid is a state of matter that has a definite shape and volume. In a solid, particles of matter are tightly packed together. The particles cannot change position easily. They can only vibrate, or move back and forth in place.

2 DEFINE: What is a solid?

Liquid Milk is a liquid. A liquid has a definite volume but no definite shape. Liquids are able to change shape because the particles of a liquid can change position. They can slide past one another. If you pour a liter of milk into different containers, the milk always takes the shape of the container. However, the volume of the milk stays the same. You cannot make a liter of milk fit into a half-liter bottle.

3 EXPLAIN: Why can liquids change shape?

Gases A gas is a state of matter that has no definite shape or volume. A gas takes the shape of its container. For example, air can take the shape of a basketball, a football, or a bicycle tire. If you fill a balloon with air, the air completely fills the balloon. A container of gas is always completely full. The particles of a gas are in constant motion. They are much farther apart than the particles in solids or liquids. They can move freely to all parts of a container.

4 DEFINE: What is a gas?

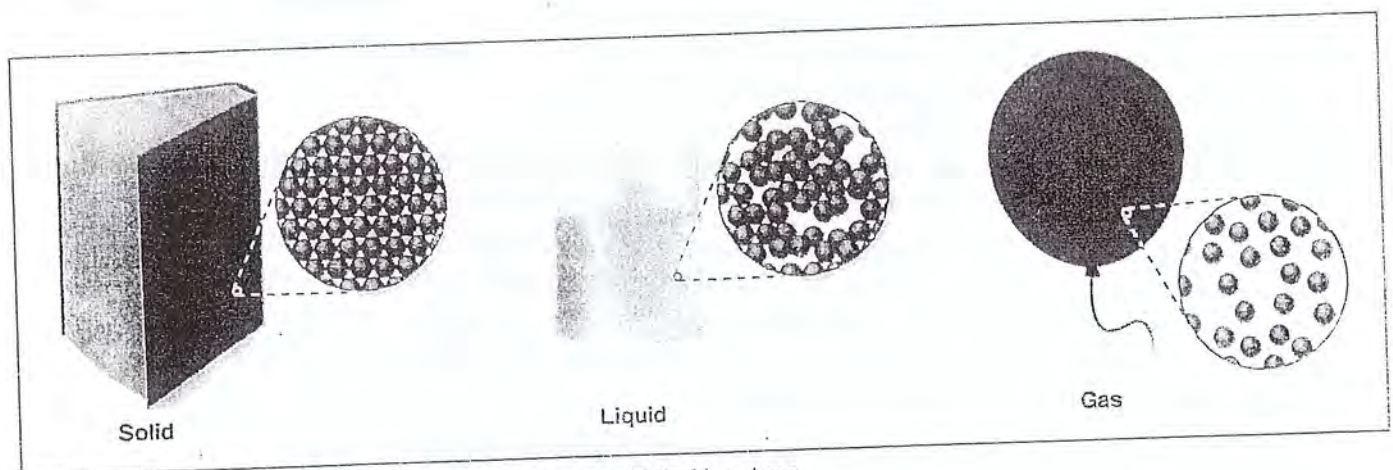


Figure 1-6 The three most common states of matter are solid, liquid, and gas.

Another State of Matter Matter can exist in a fourth state called plasma. Plasma is rare on Earth, but it is plentiful in other parts of the universe. Plasma has been found in stars, where the temperatures and pressures are very high. Matter in the plasma state is made up of small, electrically charged particles.

Scientists have been able to create plasmas in the laboratory. Such plasmas are relatively cool compared with natural plasmas. This plasma technology has been applied to many things you see everyday, such as flat-screen TVs, street lamps, and fluorescent tubes.

 **DEFINE:** What is plasma?

CHECKING CONCEPTS

1. Plasma exists where _____ and pressure are very high.
2. In what state of matter can particles only vibrate in place?
3. What happens to the shape of a liquid when you pour it into a container?
4. What determines the volume of a gas?
5. What state of matter is air?



Integrating Earth Science

TOPIC: Earth's layers

EARTH'S MANTLE

The outer layer of Earth is called the crust. The crust is about 5 to 40 km thick, with the thickest part under the mountains. Beneath the crust is the mantle. The mantle is about 2,900 km thick. The upper part of the mantle is solid rock. Below the solid rock, the mantle rock behaves like a very thick liquid, such as molasses. This is because of very high pressure and temperatures. Like all liquids, this rock can flow. The rock also has some properties of a solid. It is in an in-between state of matter called the plastic state. A plastic material is neither a solid nor a liquid; it has properties of both.

Scientists would like to learn more about the plastic material in the mantle. However, they have not been able to drill that far into Earth. What they know has been learned by studying shock waves from earthquakes. Someday, scientists hope to find a way to drill deep enough to reach the mantle. Then, they will be able to study the properties of plastic rock directly.

Thinking Critically What might scientists do with the information they get from the plastic rock?

THINKING CRITICALLY

6. **EXPLAIN:** What will happen to the particles of a gas if the gas is transferred from a small container to a much larger container?
7. **CLASSIFY:** Classify each of the following substances as a solid, a liquid, or a gas.

a. Cotton cloth	f. Seltzer
b. Rain	g. Hydrogen
c. Carbon dioxide	h. Sugar
d. Helium	i. Orange juice
e. Salt	j. Bricks

Web InfoSearch

Plasma As rare as plasma is on Earth, scientists have found ways to make use of it in some interesting ways.

SEARCH: Use the Internet to find out what kinds of products contain plasma. Then, create a chart. Next to each item on your list, include a picture of it. Start your search at www.conceptsandchallenges.com. Some key search words are plasma and digital TV.

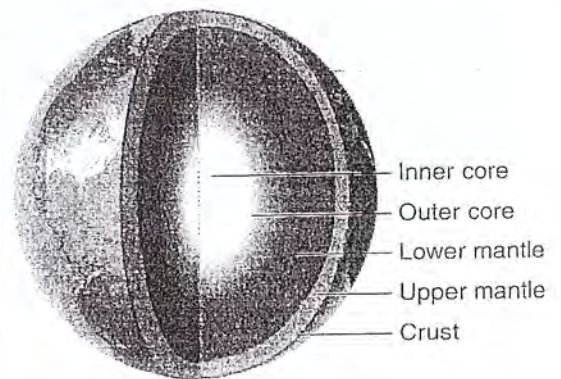


Figure 1-7 Earth's interior

1-4 How does matter change state?

Objective

Identify ways in which matter can change from one state to another.

Key Terms

freezing: change from a liquid to a solid

melting: change from a solid to a liquid

evaporation (ee-vap-uh-RAY-shuhn): change from a liquid to a gas at the surface of the liquid

condensation (kahn-dehn-SAY-shuhn): change from a gas to a liquid

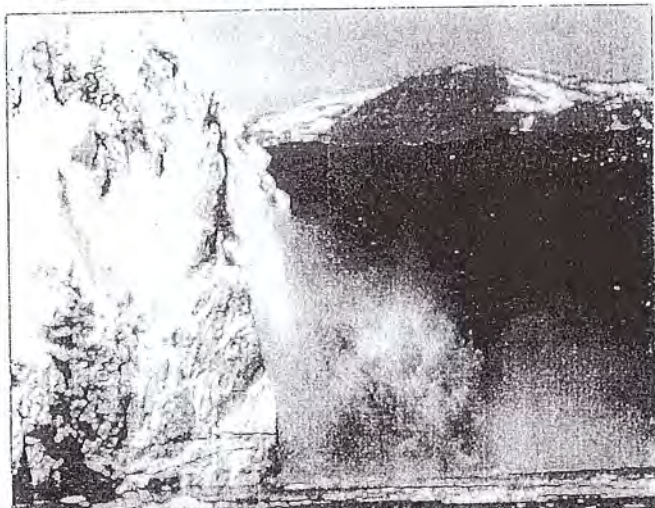
sublimation: change from a solid directly to a gas

State Changes Matter can change from one state to another. For example, water can change from a solid to a liquid. A change in matter from one state to another is called a change of state. There are five main kinds of changes of state. During a change of state, there is a change in heat energy. A substance either gains or loses heat as it changes from one state to another.

1 DESCRIBE: What is a change of state?

Freezing and Melting If you fill an ice cube tray with water and place it in the freezer, the water will change to ice. Water changing into ice is an example of freezing. Freezing is a change from a liquid to a solid. Freezing occurs when the temperature of a liquid reaches its freezing point. At its freezing point, a liquid loses enough heat to change to a solid.

▼ Figure 1-8 Part of this frozen iceberg is melting into the ocean.



When the temperature rises above the freezing point of water, ice changes to a liquid. A change from solid to liquid is called melting. Melting occurs when a solid gains enough heat to change into a liquid.

2 EXPLAIN: What causes a liquid to freeze?

Evaporation Before you go to bed tonight, fill an open plastic container with water. Mark the level of the water. Place the container in a warm, dry place. When you get up tomorrow, see what has happened to the water level. You will find that some of the water has "disappeared." Particles at the surface of the water gained enough heat energy to change into the gas state. Evaporation is a change from a liquid to a gas at the surface of the liquid.

You probably have noticed drops of water on your bathroom mirror after taking a hot shower. Hot water from the shower causes the temperature in the bathroom to rise. Some water particles gain enough heat energy to change to water vapor. Water vapor is the gas state of water. Water vapor is invisible. As particles of water vapor hit the cool surface of a mirror, they lose heat energy and change back into liquid water. This process is called condensation. Condensation is a change from a gas to a liquid.

3 EXPLAIN: What causes condensation?

Sublimation When you fill an ice cube tray with water and place it in the freezer, you have ice cubes in a few hours. If you leave the tray untouched in the freezer for several days, the ice cubes get smaller. This is due to a process called sublimation. Sublimation is the changing of a solid directly to a gas, without passing through a liquid state. The temperature at which a solid changes to a gas is its sublimation point. Some other solids that sublime are moth balls (naphthalene), dry ice (CO_2), and iodine.

4 DEFINE: What is sublimation?

✓ CHECKING CONCEPTS

1. Melting is a change from a solid to a _____.
2. Water changing into ice is an example of _____.
3. A change in matter from one state to another is called _____.
4. A change from a liquid to a gas at the surface of the liquid is _____.
5. Water vapor changing to liquid water is an example of _____.
6. Dry ice turning into gas is an example of _____.
8. INFER: What happens to the particles of a liquid as the liquid evaporates?
9. CLASSIFY: Identify the change of state taking place in each of the following situations.
 - a. Water droplets form on the inside of your window on a chilly winter night.
 - b. A full perfume bottle left open for several days is now half empty.
 - c. A block of baking chocolate is heated until it can be poured into a measuring cup.

💡 THINKING CRITICALLY

7. INFER: What happens to the particles of a liquid as the liquid freezes?



Real-Life Science

FOG MACHINES

Dry ice is frozen carbon dioxide, a gas found in the air around us. It looks like regular ice, but it is much colder. The temperature of dry ice is about -78.5°C or -109.3°F . If dry ice comes in contact with your skin, heat is removed from your body so fast that your skin seems to burn! For this reason, dry ice should only be handled with insulated gloves.

Frozen carbon dioxide is called dry ice because it does not melt. It changes directly from a solid to a gas. This process is called sublimation. If you watch a piece of dry ice, it seems to slowly disappear into thin air as it sublimates.

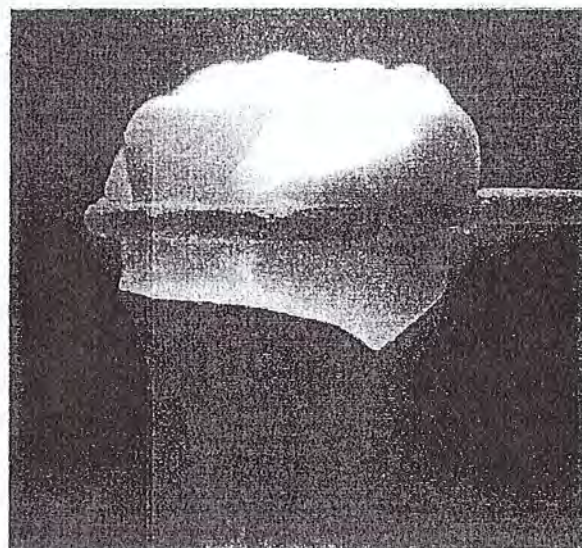
When dry ice is placed in hot water, a fog made of tiny water droplets is produced. Such fogs, produced by a fog machine, can lend a dreamlike or eerie mood to the sets of stage plays, rock concerts, or movies. A dry ice fog machine is made up of a water barrel, a heater, and a fan. Dry ice is placed in a bucket with holes in it. When the bucket is lowered into the barrel of hot water, fog is produced. The fan then blows the fog through the air. The production of fog is stopped by removing the dry ice from the water barrel.

Thinking Critically Where does the water that makes up the fog come from?

DESIGNING AN EXPERIMENT

Design an experiment to solve the following problem. Include a hypothesis, variables, a procedure, and a type of data to study.

PROBLEM: How can you identify an unknown material?



▲ Figure 1-9 Dry ice subliming

2-1 What is density?

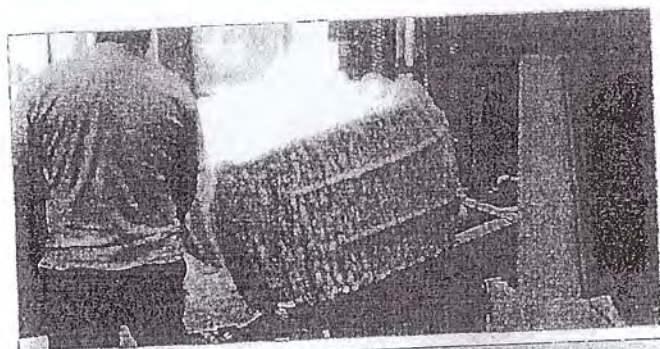
Objective

Define density.

Key Term

density (DEHN-suh-tee): mass per unit volume

Which do you think is heavier, a kilogram of cotton or a kilogram of iron? You may already know the answer to this riddle. They both weigh the same amount. However, a kilogram of cotton takes up a greater amount of space, or volume. A kilogram of iron is small enough to hold in your hand. A kilogram of iron takes up less space because iron has a much greater density than cotton does. Density is the mass per unit volume of a substance. Substances that are very heavy for their volume are called dense substances.



▲ Figure 2-2 The bale of cotton at the top has a mass of 1 kg. The iron frying pan below it also has a mass of 1 kg.

DEFINE: What is density?

Units of Density You can find the density of a substance by finding the mass of a unit volume of the substance. Units of density include units of

mass and volume. Mass is measured in grams. The volume of solids is measured in cubic centimeters. The volume of liquids can be measured in milliliters. One milliliter is equal to one cubic centimeter. Therefore, the density of any substance can be given in grams per cubic centimeter, or g/cm^3 . For example, water has a density of 1 g/cm^3 . One gram of water takes up one cubic centimeter of space. The densities of some common substances are listed in Figure 2-3.

DENSITIES OF SOME COMMON SUBSTANCES

Substance	Density (g/cm^3)
Air	0.0013
Alcohol	0.8
Aluminum	2.7
Cork	0.2
Gold	19.3
Iron	7.9
Lead	11.3
Mercury	13.6
Silver	10.5
Steel	7.8
Water	1.0

▲ Figure 2-3

IDENTIFY: In what units is density measured?

Using Density Density is a physical property of matter. Every kind of matter has a density that can be measured. The density of a pure substance is always the same. For example, the density of lead is always 11.3 g/cm^3 . The density of mercury is always 13.6 g/cm^3 . Density does not depend on the size or shape of the substance.

Density can be used to help identify different kinds of matter. Suppose two metals look similar. You know that one may be silver and the other aluminum. If you know the density of each sample, you can identify them. The sample with a density of 10.5 g/cm^3 is silver. The sample with a density of 2.7 g/cm^3 is aluminum.

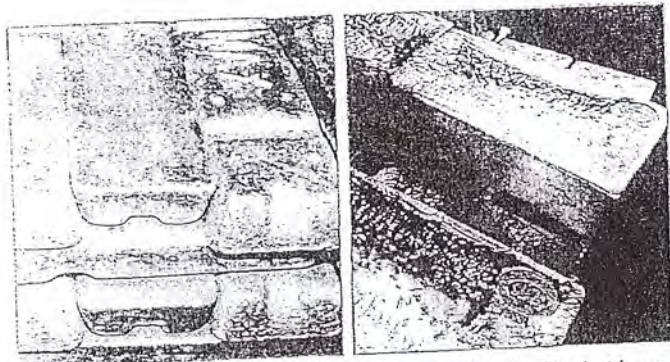


Figure 2-4 Aluminum (left) and silver (right) look alike but have different densities.

IDENTIFY: What kind of property is density?

✓ CHECKING CONCEPTS

1. Density is the _____ per unit volume of a substance.
2. When a substance has a high density, a large mass fits into a _____ volume.
3. The units of _____ are grams per cubic centimeter.

Integrating Earth Science

TOPICS: neutron stars, black holes

THE DENSEST OBJECTS IN THE UNIVERSE

What are the densest objects thought to exist? The answer is neutron stars and black holes. Here is how they form. A new star is made mostly of hydrogen. As millions of years pass, the hydrogen fuses and changes into helium. When the hydrogen is used up, the star becomes a red giant or a supergiant.

Supergiants start out with a much greater mass than the mass of our Sun. Such massive stars may blow up in a huge explosion called a supernova. After the explosion, some of the star's matter gets squeezed into a very dense object called a neutron star. The density of a neutron star is enormous. One teaspoon of matter from a neutron star would have a mass of 100 billion tons!

Some supergiants do not become neutron stars. The most massive stars collapse into black holes. A black hole has a density even greater than that of a neutron star. The density of a black hole behaves as if it is infinite. Not even light escapes the strong pull of gravity in a black hole.

Thinking Critically Explain the meaning of the name "black hole."

4. Density is a physical _____ of all matter.
5. The density of silver is always _____.

THINKING CRITICALLY

6. **CALCULATE:** What is the density of a metal block that has a mass of 525 g and a volume of 50 cm³?
7. **PREDICT:** How large a container would be needed to hold 800 g of water?
8. **SEQUENCE:** List the following substances in order from lowest density to highest density: iron, gold, steel, water, air, silver, and aluminum.

DESIGNING AN EXPERIMENT

Design an experiment to solve the following problem. Include a hypothesis, variables, a procedure, and a type of data to study.

PROBLEM: How can you determine the density of chalk?

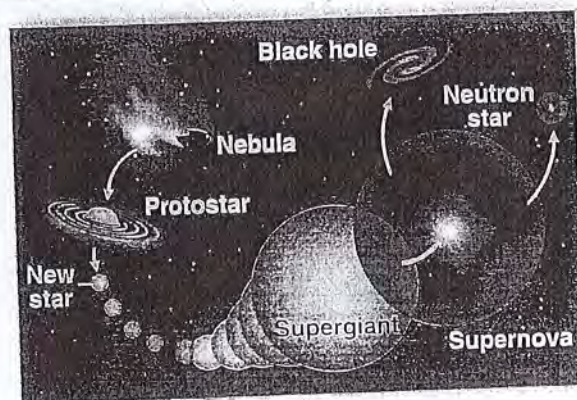


Figure 2-5 Stages in the life of a star

3-2 What are atoms?

Objectives

- Identify an atom as the smallest part of an element that can be identified as that element.
- List the main parts of Dalton's atomic theory.

Key Term

atom: smallest part of an element that can be identified as that element

The element silicon cannot be broken down into a simpler type of matter. But what would happen if you took a piece of silicon and cut it into smaller and smaller pieces? There would be a piece of silicon so small that it could not be further divided. This smallest piece of the element silicon is called an atom. An atom is the smallest part of an element that can be identified as that element.

▶ **INFER:** What would happen if you cut a piece of an element into smaller and smaller pieces?

Democritus The first person to suggest the idea of atoms was the Greek philosopher Democritus (dih-MAHK-ruh-tuhs). More than 2,400 years ago, Democritus asked whether it is possible to divide a sample of matter forever into smaller and smaller pieces. After much observation, he came to the conclusion that it is not possible to divide matter forever. At some point, a smallest piece of matter would be reached. Democritus named this smallest piece of matter an atom. The word *atom* comes from a Greek word that means "cannot be divided."

Democritus and his students did not know what atoms looked like. They did not know what scientists today know about atoms. However, they hypothesized that atoms were small, hard particles that were all made out of the same material but were of different shapes and sizes. They also thought that atoms were infinite in number, that they were always moving, and that they could be joined together.

▶ **STATE:** What does the word *atom* mean?

In the early 1800s, an English chemist named John Dalton performed some experiments. He investigated properties of gases. His observations led him to believe that gases are made of individual particles. These individual particles are very similar to the idea of the atom proposed by Democritus. The results of his experiments and other observations about matter led Dalton to state an atomic theory of matter. The main parts of Dalton's atomic theory of matter are as follows:

All elements are composed of atoms. Atoms cannot be divided or destroyed.

Atoms of the same element are exactly alike.

Atoms of different elements are different from each other.

The atoms of two or more elements can join together to form types of matter called compounds.

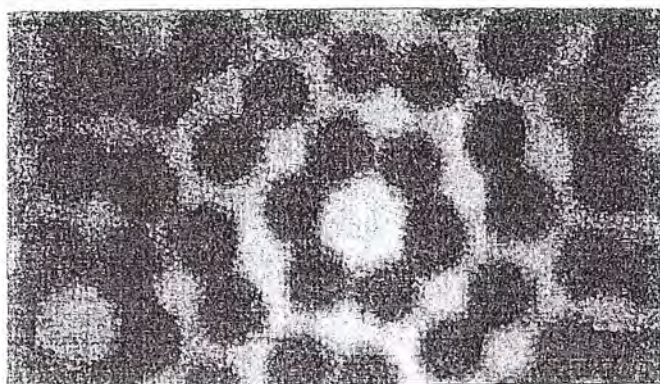
Like Democritus, Dalton had some ideas about atoms that scientists no longer agree with. However, Dalton's atomic theory was the beginning of the modern theory of atoms.



▲ Figure 3-6 John Dalton

▶ **LIST:** What are the main parts of Dalton's atomic theory of matter?

Images of Atoms Atoms are extremely small. As small as they are, a special tool, called a scanning tunneling microscope (STM), can capture images of them. Figure 3-7 shows an image captured by an STM.



▲ Figure 3-7 An image of silicon atoms produced by an STM

▶ NAME: What is an STM?

✓ CHECKING CONCEPTS

1. What is an atom?
2. Who was the first person to use the word *atom*?



Science and Technology

PARTICLE ACCELERATORS

A particle accelerator is a device used to increase the energy of electrically charged particles. At very high speeds, these charged particles smash into atoms and break them apart. Then, scientists can study the pieces that are left after the collision.

Scientists use particle accelerators to study the forces that hold matter together. The machines speed up particles and race them around and around giant, usually circular, tracks. Many accelerators have one group of particles moving in one direction and another group moving in the other direction. When the particles are traveling fast enough, they are made to crash into each other. From their work with accelerators, scientists have been able to learn more about the parts that atoms are made of.

Particle accelerators are among the largest instruments ever built. In Batavia, Illinois, a particle accelerator is built around a 6.4-km circular track. A particle accelerator in Switzerland is built in a circular underground tunnel that is 27 km wide.

Thinking Critically Why do you think particle accelerators are so large?

3. Whose investigation on properties of gases led him to propose an atomic theory of matter?
4. What is the name of the tool that can capture images of an atom?



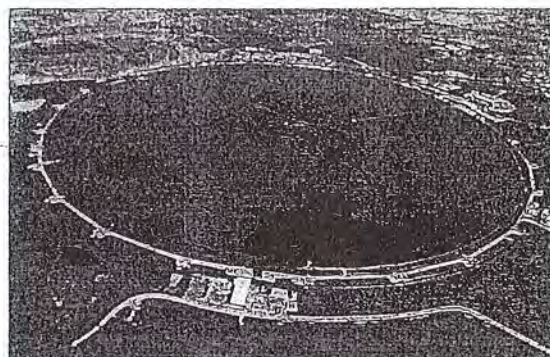
THINKING CRITICALLY

5. COMPARE: How are the ideas of Democritus and Dalton similar? How are they different?
6. INFER: How can an STM help prove Dalton's theory?

Web InfoSearch

Scanning Tunneling Microscopes STMs can take images of atoms.

SEARCH: Use the Internet to find out about the inventors of this type of microscope. Start your search at www.conceptsandchallenges.com. Some key search words are Heinrich Rohrer and Gerd Karl Binnig.



▲ Figure 3-8 In Batavia, Illinois, a particle accelerator lies under the circular outline.

3-3 What are the parts of an atom?

Objective

Identify the three basic parts of an atom.

Key Terms

nucleus: center, or core, of an atom

proton: particle that has a positive charge

neutron: particle that has no charge

electron: particle that has a negative charge

Structure of an Atom According to the modern atomic theory, an atom has a center, or core, called the nucleus. In the nucleus are protons and neutrons. A proton is a particle that has a positive charge (+). A neutron is a particle that does not have any charge. Surrounding the nucleus is a cloud of very tiny particles called electrons. An electron is a particle that has a negative charge (-). The negative charge on an electron is exactly equal to the positive charge on a proton.

STATE: Where is the nucleus found?

Thomson's Model The first scientist to suggest that an atom contains smaller particles was J. J. Thomson of England. In 1897, Thomson passed an electric current through a gas. He found that the gas gave off rays made up of negatively charged particles. Today, these particles are known as electrons. Because atoms are neutral, Thomson reasoned that there must also be positively charged particles inside an atom. Thomson hypothesized that an atom was made up of a positively charged material with negatively charged particles scattered evenly throughout.

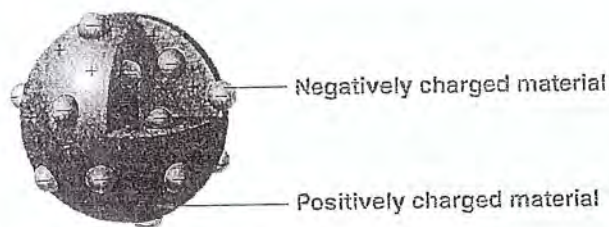


Figure 3-9 Thomson's model of an atom

IDENTIFY: What type of particle did Thomson discover in an atom?

In 1911, a British scientist named Ernest Rutherford performed an experiment to test Thomson's atomic model. Rutherford discovered that an atom is mostly empty space. He concluded that the positively charged particles are contained in a small central core

called the nucleus. He also concluded that the negatively charged particles were attracted to the positively charged particles found in the nucleus. This attraction holds the negatively charged particles in the atom.

DESCRIBE: What did Rutherford discover about an atom?

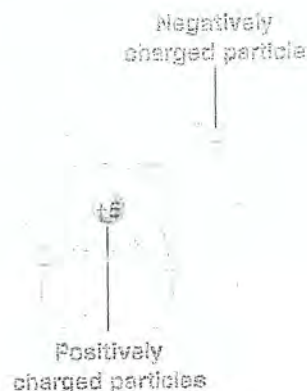


Figure 3-10 Rutherford's model of an atom

Bohr's Model

Rutherford's model of the atom was useful but it did not explain the arrangement of electrons.

In 1913, Danish scientist Niels Bohr proposed that the electrons in an atom are found in

different energy levels. Each energy level is at a certain distance from the nucleus. Electrons in different energy levels move around the nucleus in different orbits, much as the planets move in orbits around the Sun. Bohr's model explains simple atoms such as oxygen well, but it does not explain more complex atoms.

LOCATE: Where did Bohr say that electrons are found in an atom?

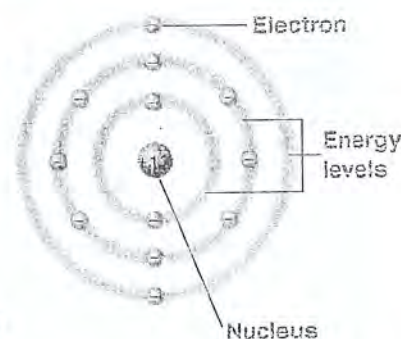


Figure 3-11 Bohr's model of an atom

Modern Model The modern atomic model is based on the works of Thomson, Rutherford, Bohr, and other scientists who have studied the nature of atoms. According to the modern model, the location of the electrons in an atom cannot be known. Therefore, the modern model of the atom does not show any paths that electrons could be found in. Instead, energy levels are used to predict the place where an electron is most likely to be found outside of the nucleus. This area is called the electron cloud. The modern model also identifies the nucleus as containing protons and neutrons.



Figure 3-12 Modern model of an atom

EXPLAIN: What is the electron cloud?



How Do They Know That?

QUARKS AND LEPTONS

In recent years, scientists have discovered that protons and neutrons are made up of even smaller particles. Based on experiments using particle accelerators, scientists have identified two groups of subatomic particles. All matter is made up of these particles. These groups of particles are known as quarks and leptons. The word *quark* was first used as the name of a subatomic particle by American physicist Murray Gell-Mann. The word *lepton* comes from a Greek word that means "small" or "thin."

Quarks make up protons, neutrons, and other particles found in the nucleus of an atom. There are six types of quarks and six types of leptons. Electrons are a type of lepton. Electrons are not believed to be made up of smaller particles. The basic particles in an atom are made up of combinations of two or three different quarks or one lepton.

Thinking Critically What is the relationship between an electron and a lepton?

CHECKING CONCEPTS

1. What are electrons?
2. Where are protons found in an atom?
3. What are the particles in an atom that do not have any charge called?
4. Who first suggested that atoms are made up of smaller particles?
5. Who discovered that an atom is mostly empty space?
6. Who proposed the idea that electrons are found in different energy levels around the nucleus?

THINKING CRITICALLY

7. **CONTRAST:** How did Rutherford's model of the atom differ from Thomson's model?
8. **EXPLAIN:** According to the modern atomic model, where are protons, neutrons, and electrons found?

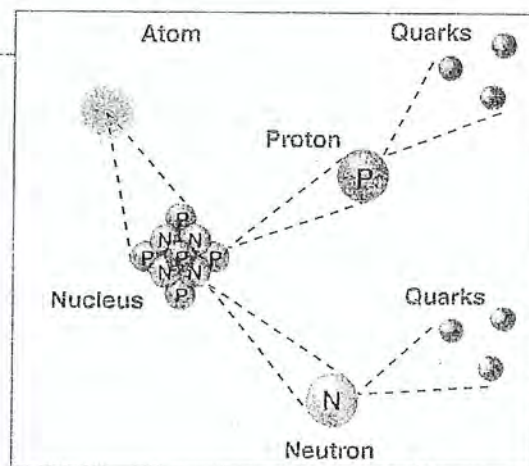


Figure 3-13 Protons and neutrons are made up of quarks.

Looking at graphs

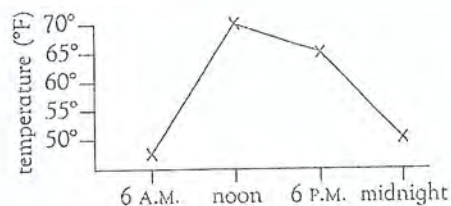


Derek recorded the temperature in his garden during one day.
At what time was the temperature at its highest?

noon

By how much did the temperature fall between 6 P.M. and midnight?

15°F



Kate keeps a record of her last 10 spelling test scores.

What was Kate's score in week 3?

14

In which 2 consecutive weeks did Kate's score stay the same?

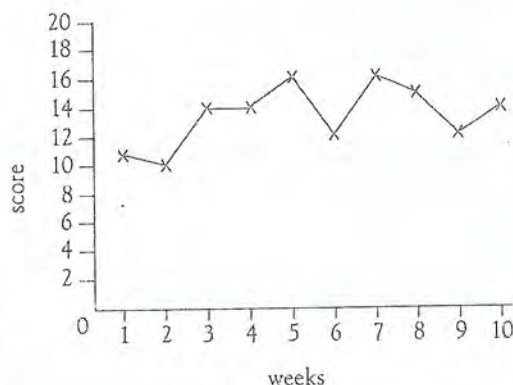
weeks 3 and 4

What was Kate's best score?

16

How much did her score improve between weeks 4 and 5?

by 2 points



The local tourist board produced a graph to show the maximum temperatures in Charleston between April and August.

What was the maximum temperature in April?

50°F

Overall, what is happening to the temperature between April and August?

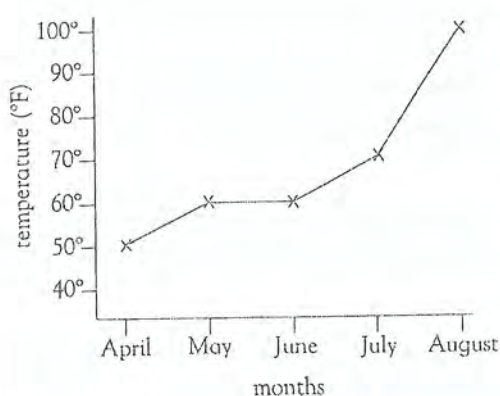
It is rising.

How much did the temperature rise between May and July?

70°F - 60°F = 10°F

Which two months had the same maximum temperature?

May and June



On this page, children are required to find two or more pieces of information on a graph. They then have to compare or find the difference in value. In the first question, make sure that children understand the meaning of consecutive.

Looking at graphs

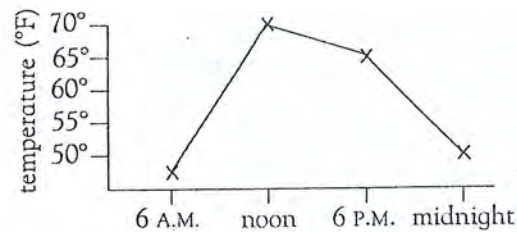


Derek recorded the temperature in his garden during one day.
At what time was the temperature at its highest?

noon

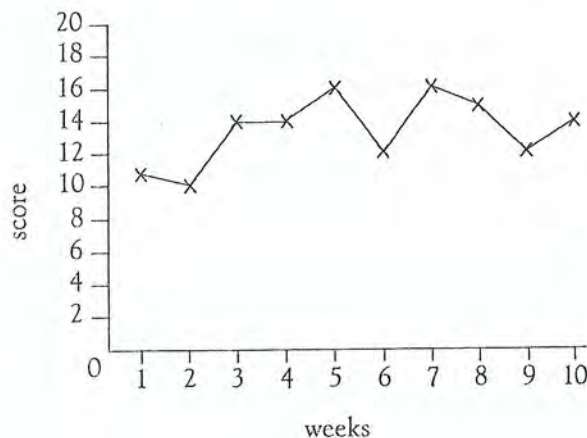
By how much did the temperature fall between 6 P.M. and midnight?

15°F



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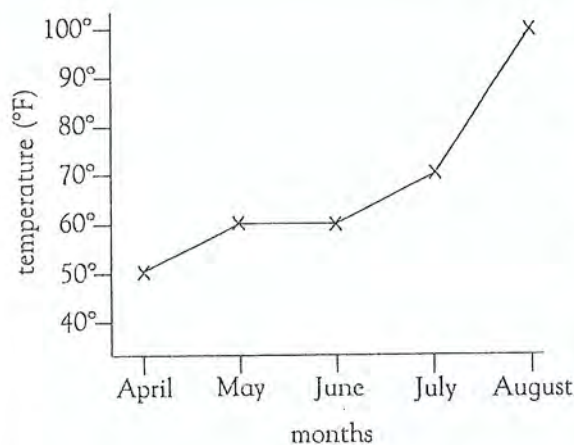


In which 2 consecutive weeks did Kate's score stay the same?

What was Kate's best score?

How much did her score improve between weeks 4 and 5?

The local tourist board produced a graph to show the maximum temperatures in Charleston between April and August.



What was the maximum temperature in April?

Overall, what is happening to the temperature between April and August?

How much did the temperature rise between May and July?

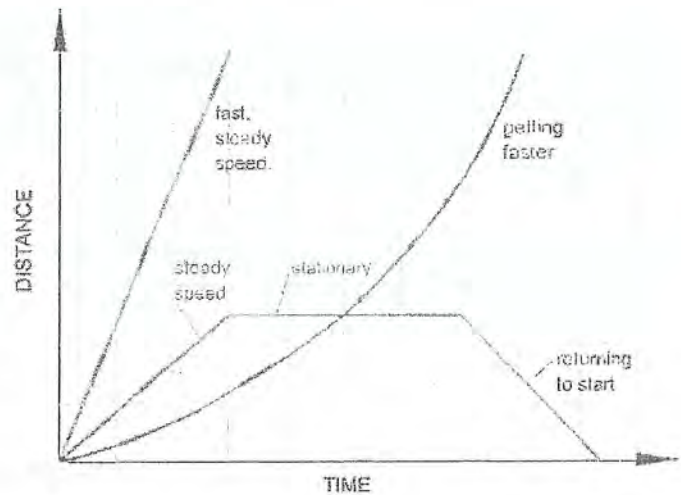
Which two months had the same maximum temperature?

Worksheet: Interpreting Graphs

CHAPTER 4: LINEAR MOTION

INTERPRETING GRAPHS- As I have said many times in class, "a picture is worth a thousand words". In physics, a graph is "worth a thousand numbers". A great deal of information can be obtained by looking and interpreting graphs describing motion (displacement, speed, velocity, and acceleration).

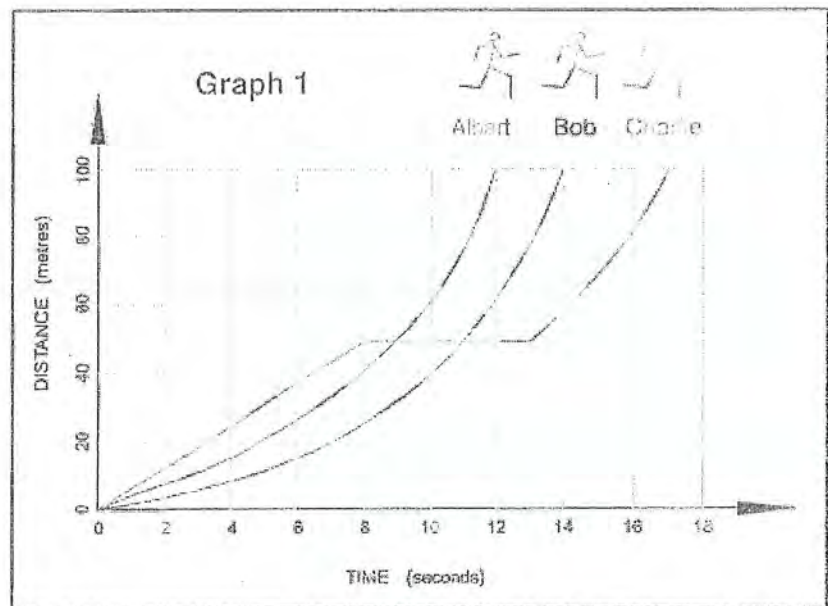
Distance vs. Time Graphs- To the right is a typical graph displaying Distance vs. Time. One or more objects may be graphed at one time, so you can compare the relative positions, speeds and displacement as they relate to each other.



Directions: Answer the following questions as they apply to the Motions graphs and diagrams.

Graph 1: Questions 1-7

1. What does the slope of each line on the graph tell you?
2. Which runner completed the 100m race in the least amount of time? What was his time?



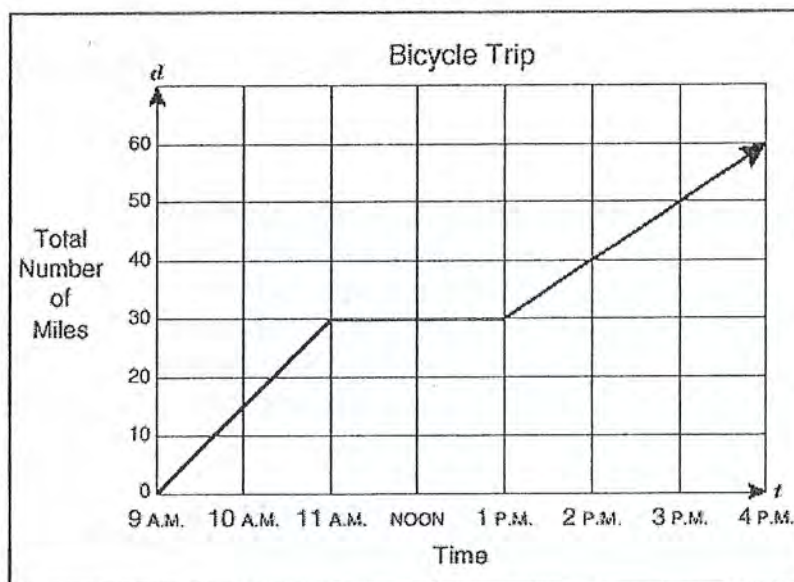
3. Which runner started out the fastest?
4. What was Charlie doing between 8 seconds and 10.5 seconds?
5. What does a straight line on this graph tell you? A curved line?
6. At what distance and time did Albert overtake Bob?
7. What was the total displacement of all three runners (Δd)?

Graph 2: Questions 8-13

8. What is happening between 9AM and 11AM?

9. What do you think bicyclist is doing between 11AM and 1PM?

10. What was the total distance covered by 11AM, 1PM, and 4PM?



11. What was the average velocity of the bicyclist between 9Am and 11AM?

12. What was the average velocity over the entire trip?

13. Is the speed a positive or negative number? Could speed ever be a negative number?

Graph 3: Questions 14-

14. What does line "a" represent?

15. What is the difference in velocities between points a, b, and c?

16. What do we call it when velocity changes over time?

17. What is the average velocity between time 0 and 3 seconds?
Show your work.

