RB

6th grade

ISP

Math | Science | ELA
History

Math Review Packet for 6th Grade Math

Level 2

Decimals, Fractions, Ratios, Rates, Percent, Comparing Integers, Coordinate Plane, Perimeter, Area, Volume, Evaluating Expressions, One-Step Equations, & Problem Solving

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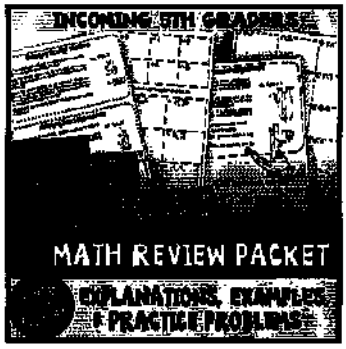
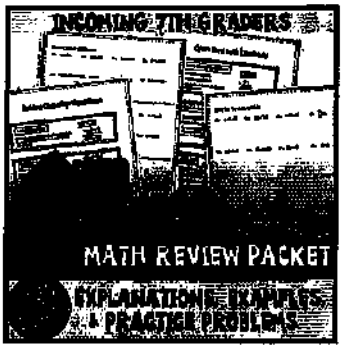
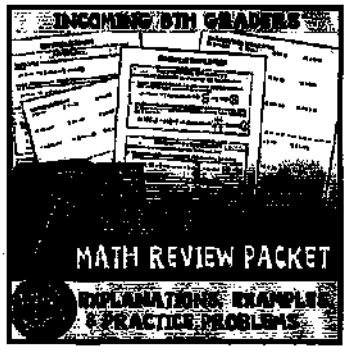
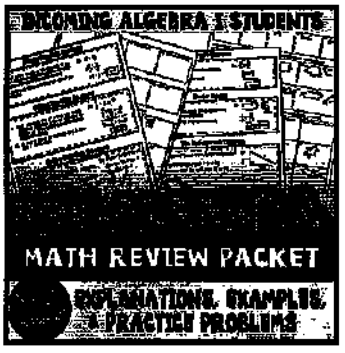
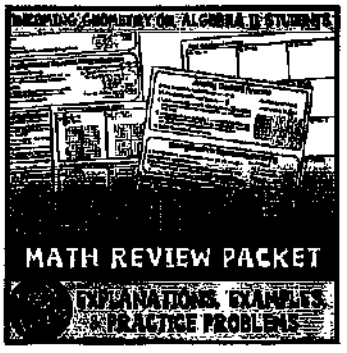










Adding & Subtracting Decimals

1. Write the problem vertically, lining up the decimal points.
2. Add additional zeroes at the end, if necessary, to make the numbers have the same number of decimal places.
3. Add/subtract as if the numbers are whole numbers
4. Bring the decimal point straight down

ex: 14.2 - 7.934

$$\begin{array}{r} 14.200 \\ -\ 7.934 \\ \hline 6.266 \end{array}$$

Multiplying Decimals

1. Write the problem vertically with the numbers lined up to the right. The decimal points do NOT need to be lined up.
2. Ignore the decimals and multiply as if the numbers are whole numbers.
3. Count the total number of decimal places in the factors and put a decimal point in the product so that it has that same number of decimal places.

ex: 6.94 x 7.8

$$\begin{array}{r} 6.94 \\ \times\ 7.8 \\ \hline 5552 \\ +\ 48580 \\ \hline 54132 \end{array}$$

2 decimal places + 1 decimal place = 3 decimal places

54.132

Dividing Decimals

1. Write the dividend under the long division symbol and the divisor to the left of it.
2. Move the decimal point in the divisor after the number to turn it into a whole number and then move the decimal in the dividend the same number of places. Then bring it up.
3. Divide as if the numbers are both whole numbers.
4. Annex zeros in the dividend as needed until there is no remainder. If your answer is a repeating decimal, write the answer using bar notation.

ex: 25.3 ÷ 0.3

$$0.3\overline{)25.3\overset{\uparrow}{0}} = 84.\overline{3}$$

$$\begin{array}{r} -24 \\ \hline 13 \\ -12 \\ \hline 10 \\ -\ 9 \\ \hline 1 \end{array}$$

Order of Operations

1. Grouping Symbols (parentheses, brackets, etc.)
2. Exponents
3. Multiplication & Division (left to right)
4. Addition & Subtraction (left to right)

ex: $5 + 4(3 - 1.2)$

$5 + 4(1.8)$

$5 + 7.2$

12.2

Evaluate each expression.

1. $5.983 + 2.99$	2. $224 - 56.73$	3. $6.12 - 4.923$
4. $24.5 \cdot 3.2$	5. $0.23 \cdot 7$	6. $3.86 \cdot 9.15$
7. $14.8 \div 5$	8. $46.3 \div 1.5$	9. $147 \div 2.25$
10. $24.33 - 2.5 \cdot 7$	11. $3.9 + 4.5^2$	12. $9.25(18.4 - 2 \cdot 1.2)$

Solve each word problem, showing all work.

13. Jeff had \$46.18 in his wallet Monday morning. He gave half of his money to his brother. He then bought two donuts for \$0.75 each and a cup of coffee for \$2.99. How much money did Jeff have left?	14. Five friends split a \$65.20 bill at a restaurant. They also each left \$2.75 for the tip. How much money did each person pay in all?

Adding Fractions & Mixed Numbers

1. Find a common denominator for the two fractions.
2. Add the two numerators and keep the denominator the same.
3. Add the whole numbers.
4. Simplify the answer and/or change improper fraction answers to mixed numbers.

ex: $3\frac{3}{4} + 2\frac{1}{2}$

$3\frac{3}{4} = 3\frac{3}{4}$

$+ \quad 2\frac{1}{2} = 2\frac{2}{4}$

$5\frac{5}{4} = \boxed{6\frac{1}{4}}$

Subtracting Fractions & Mixed Numbers

1. Find a common denominator for the two fractions.
2. Subtract the two numerators and keep the denominators the same. If the top numerator is smaller than the bottom numerator, borrow from the whole number and rename the top fraction.
3. Subtract the whole numbers.
4. Simplify the answer.

ex: $5\frac{1}{4} - 1\frac{2}{3}$

$5\frac{1}{4} = 5\frac{3}{12} = 4\frac{15}{12}$

$- \quad 1\frac{2}{3} = 1\frac{8}{12} = 1\frac{8}{12}$

$\boxed{3\frac{7}{12}}$

Multiplying Fractions & Mixed Numbers

1. Turn any mixed numbers and whole numbers into improper fractions.
2. Cross-simplify if possible.
3. Multiply the numerators and then multiply the denominators
4. Simplify the answer and/or change improper fraction answers to mixed numbers.

ex: $2\frac{1}{6} \cdot \frac{4}{7}$

$\frac{13}{3\cancel{6}} \cdot \frac{\cancel{4}^{2}}{7} = \frac{26}{21} = \boxed{1\frac{5}{21}}$

Dividing Fractions & Mixed Numbers

1. Turn any mixed numbers and whole numbers into improper fractions.
2. Keep the first fraction the same, change the division to multiplication, and flip the second fraction to its reciprocal.
3. Multiply the fractions.
4. Simplify the answer and/or change improper fraction answers to mixed numbers.

ex: $7 \div 1\frac{3}{4}$

$\frac{7}{1} \div \frac{7}{4}$

$\frac{1}{\cancel{7}_{1}} \cdot \frac{4}{\cancel{7}_{1}} = \frac{4}{1} = \boxed{4}$

Evaluate each expression.

15. $\frac{4}{5} + \frac{3}{4}$	16. $4\frac{2}{7} + 2\frac{9}{14}$	17. $8\frac{11}{12} + 9\frac{5}{18}$
18. $6 - \frac{3}{8}$	19. $8\frac{3}{5} - 2\frac{1}{3}$	20. $4\frac{1}{6} - \frac{8}{9}$
21. $\frac{4}{25} \cdot \frac{15}{16}$	22. $2\frac{3}{4} \cdot 8$	23. $6\frac{5}{8} \cdot 3\frac{1}{2}$
24. $\frac{7}{9} \div \frac{2}{3}$	25. $\frac{4}{5} \div 10$	26. $5\frac{2}{3} \div 2\frac{5}{6}$

Solve each word problem, showing all work.

27. Jaimie ran $3\frac{1}{2}$ miles on Monday. She ran half as far on Tuesday as she did on Monday. How far did Jaimie run in all on Monday and Tuesday?	28. A $5\frac{1}{2}$ quart pot is filled $\frac{2}{3}$ of the way with water. How many more quarts of water can the pot hold?

Ratios

Ratios are comparisons of two quantities.
There are 3 different ways to write ratios:

- Fraction $\left(\frac{A}{B}\right)$
- Colon (A:B)
- Word Form (A to B)

Ratios can be simplified just like fractions.

ex: write the ratio of triangles to circles in 3 ways: ▲▲▲▲●●

$\frac{4}{2} = \boxed{\frac{2}{1},\ 2:1,\ 2 \text{ to } 1}$

Rates & Unit Rates

Rates are ratios that compare quantities measured in different units.
A unit rate is a rate with a denominator of 1.

To convert a rate to a unit rate:

1. Divide the numerator by the denominator
2. Either write your answer as a fraction with a label for the both the numerator and denominator OR as one number labeled with the first unit "per" the second unit

ex: express as a unit rate: 125 miles in 4 hours

$\frac{125 \text{ mi}}{4 \text{ hr}}$ $125 \div 4 = 31.25$

$\boxed{\frac{31.25 \text{ mi}}{1 \text{ hr}} \text{ or } 31.25 \text{ miles per hr}}$

Fractions, Decimals, & Percent

To convert a:

- Decimal to Percent: move the decimal point 2 places to the right — ex: $0.345 = \boxed{34.5\%}$
- Percent to Decimal: move the decimal point 2 places to the left — ex: $.7\% = \boxed{0.07}$
- Decimal to Fraction: write the decimal over the place value of the last digit and then simplify — ex: $0.008 = \frac{8}{1000} = \boxed{\frac{1}{125}}$
- Fraction to Decimal: divide the numerator by the denominator — ex: $\frac{1}{5} = 5\overline{)1.0}$ $\boxed{0.2}$
- Percent to Fraction: write the percent over 100 and then simplify — ex: $45\% = \frac{45}{100} = \boxed{\frac{9}{20}}$
- Fraction to Percent: convert the fraction to a decimal and then convert the decimal to a percent — ex: $\frac{3}{10} = 0.3 = \boxed{30\%}$

Percent of a Number

1. Turn the percent to a fraction or decimal.
2. Multiply the fraction/decimal by the number.

ex: Find 18% of 40

$0.18 \cdot 40 = \boxed{7.2}$

Write each ratio in 3 ways.

29. A bank contains 15 pennies and 12 nickels. Write the ratio of nickels to pennies.	30. A bowl contains 6 apples and some bananas. If there are a total of 10 pieces of fruit, find the ratio of apples to bananas.

Convert each rate to a unit rate.

31. $4.25 for 64 fluid ounces	32. 297 miles on 11 gallons of gas	33. 124 feet in 10 seconds

Complete the chart by converting each number to a percent, fraction, and/or decimal.

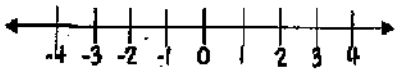
Fraction	Decimal	Percent
34. $\frac{3}{8}$		
35.	0.45	
36.		72%
37.	0.1	
38. $\frac{3}{200}$		

Find each percent of a number.

39. 30% of 90	40. 15% of 38	41. 50% of 86
42. 75% of 160	43. 24% of 35	44. 2% of 74

Comparing Integers

Integers are numbers without fractional parts. They can be positive, negative, or zero. The further right a number is on the number line, the greater it is.



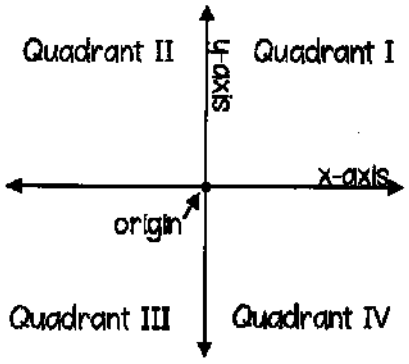
The absolute value of a number is the distance the number is from zero.

ex: compare with <, >, or =

$-7 \bigcirc |-9|$ ← The absolute value of $-9 = 9$

$-7 \boxed{<} 9$

The Coordinate Plane

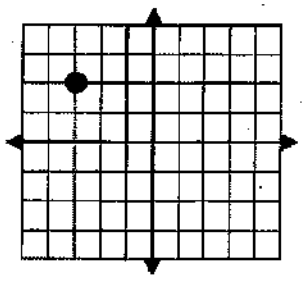


Ordered Pair: (x, y)

To graph a point on the coordinate plane, start at the origin. The first number in the ordered pair (the x-coordinate) tells you how far left (if negative) or right (if positive) to move. The second number (the y-coordinate) tells you how far up (if positive) or down (if negative) to move.

ex: Graph the point (-3, 2) and state the quadrant in which it is located.

Start at the origin, and move LEFT 3 and UP 2

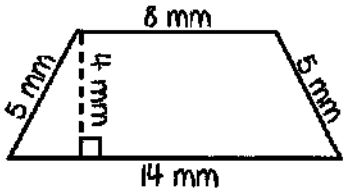


Quadrant II

Perimeter, Area and Volume

- Perimeter of Any Polygon: add all side lengths
- Area of a Rectangle: $A = lw$
- Area of Parallelogram: $A = bh$
- Area of Triangle: $A = \frac{1}{2}bh$
- Area of Trapezoid: $A = \frac{1}{2}h(b_1 + b_2)$
- Volume of Rectangular Prism: $V = lwh$

ex: Find the perimeter & area:



Perimeter: $P = 5 + 8 + 5 + 14 =$ **32 mm**

Area: This is a trapezoid, so use the area of a trapezoid formula: $A = \frac{1}{2}h(b_1 + b_2)$

The bases are the sides that are parallel, and the height is perpendicular to the bases.

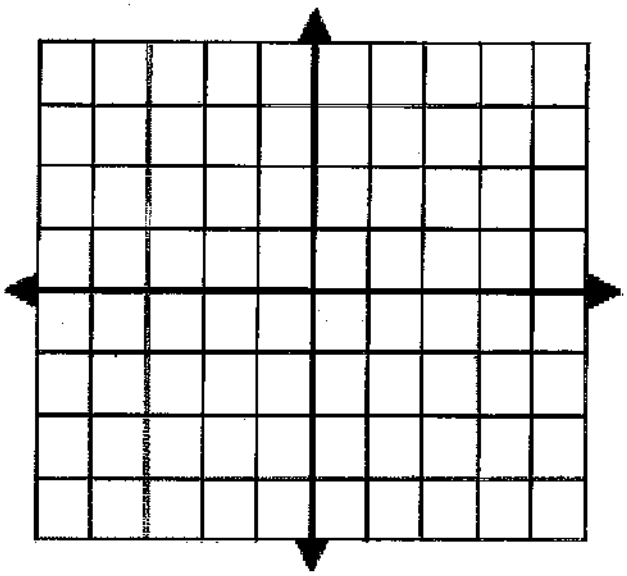
→ $A = \frac{1}{2}(4)(8+14) =$ **44 mm²**

Compare the integers with <, >, or =.

45. $-4 \bigcirc -5$	46. $2 \bigcirc -2$	47. $\lvert -5 \rvert \bigcirc \lvert 5 \rvert$	48. $-7 \bigcirc 6$	49. $-13 \bigcirc -9$
50. $\lvert -7 \rvert \bigcirc -6$	51. $-17 \bigcirc -14$	52. $\lvert -3 \rvert \bigcirc \lvert -2 \rvert$	53. $0 \bigcirc -6$	54. $\lvert -4 \rvert \bigcirc \lvert 6 \rvert$

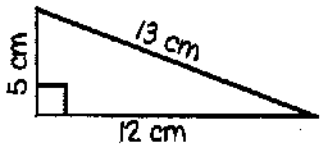
Graph and label each of the ordered pairs in the coordinate plane. Then state the quadrant or axis in/on which the point is located.

55. A(2, 4)	56. B(0, -3)
57. C(1, -1)	58. D(3, 3)
59. E(-4, 1)	60. F(2, 0)
61. G(-3, -2)	62. H(-2, 3)
63. I(0, 2)	64. J(-1, -4)

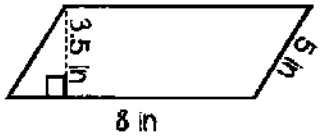


Find the perimeter, area, and/or volume of the given figure.

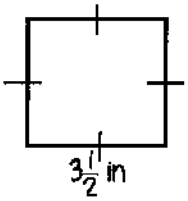
65. Find the perimeter & area:



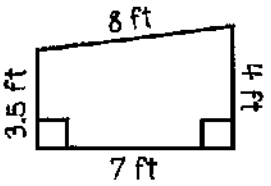
66. Find the perimeter & area:



67. Find the perimeter & area:

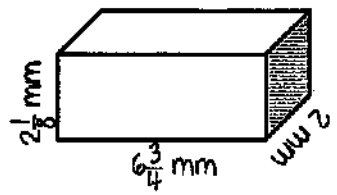


68. Find the perimeter & area:



69. Find the area of a square with a perimeter of 45 cm

70. Find the volume:



Evaluating Algebraic Expressions

1. Substitute the given numbers for the variables
2. Evaluate the expression using the order of operations

ex: evaluate $x + 4y$ for $x = 4$ & $y = 6$

$4 + 4(6)$

$4 + 24 = \boxed{28}$

One-Step Addition & Subtraction Equations

- Addition Equations: Subtract the number being added to the variable from both sides of the equation

ex: $4 + x = 18$

$-4 \quad -4$

$\boxed{x = 14}$

- Subtraction Equations: Add the number being subtracted from the variable to both sides of the equation

ex: $20 = a - 5$

$+5 \quad +5$

$25 = a \rightarrow \boxed{a = 25}$

One-Step Multiplication & Division Equations

- Multiplication Equations: Divide both sides of the equation by the number next to the variable

ex: $\frac{7b}{7} = \frac{28}{7}$

$\boxed{b = 4}$

- Division Equations: Multiply both sides of the equation by the number under the variable

ex: $5 \cdot \frac{n}{5} = 10 \cdot 5$

$\boxed{n = 50}$

Problem Solving

1. Read the problem. Identify the question that is being asked and the key information in the problem.
2. Plan how you are going to solve the problem and estimate the answer.
3. Solve the problem using the strategy of your choice.
4. Check your answer. Make sure your answer is reasonable and compare it to your estimate. Label your answer with appropriate units.

Evaluate each expression for $a = 5$, $b = 12$, $c = 10$, & $d = 2$.

71. $2b - a$	72. $d(ab - c)$	73. $3 + \frac{b}{d}$
74. $\frac{4a}{b + 4d}$	75. $2a^2 - c$	76. $b - c + d$

Solve each one-step equation.

77. $g + 3 = 17$	78. $r - 6 = 7$	79. $6b = 18$	80. $\frac{h}{9} = 3$
81. $5 = f - 8$	82. $48 = 12b$	83. $a + 24 = 83$	84. $17 + x = 23$
85. $10 = \frac{m}{5}$	86. $86.5 = f - 7.63$	87. $\frac{n}{6} = 11$	88. $\frac{3}{4}h = 12$

Solve each word problem using the method of your choice.

89. A fencing company charges $22 per foot to install a wood fence. How much will it cost to install a wood fence around a rectangular pool area that is 20 feet wide and 38 feet long?

90. A 6 inch-tall plant grew ¾ of an inch one week and twice as much the following week. How tall is the plant now?

91. Jack can read 45 pages of his book in one and a half hours. At that rate, how long will it take him to read the entire 300-page book?

92. Brian ordered 3 large cheese pizzas and a salad. The salad cost $4.95. If he spent a total of $47.60 including the $5 tip, how much did each pizza cost? (Assume there is no tax).

93. A cookie recipe calls for $3\frac{1}{4}$ cups of flour. The recipe makes 3 dozen cookies. How much flour is needed to make 144 cookies?

94. Ella has a box of chocolate candies. She gives $\frac{1}{3}$ of the candies to her sister, 4 to her brother, and she eats the remaining 12 candies. How many chocolate candies were in the box originally?

Solve each word problem using the method of your choice.

95. 20% of the 520 students in Wendover Middle School were involved in school sports. Of those students, 12.5% were on the wrestling team. How many students were on the wrestling team?

96. A piggy bank contains some dimes and nickels. There are 8 more dimes than nickels in the bank. There is a total of $1.40. How many of each type of coin are in the bank?

97. An elevator in a tall building goes up 7 floors, then down 9 floors, down 4 floors, up 8 floors, and down 2 floors. Now it is on floor 14. On what floor did the elevator start?

98. Jenna danced for 3 hours on Sunday, 2 hours on Monday and Tuesday, 1 hour on Thursday, 1.5 hours on Friday, and 2 hours on Saturday. She did not dance at all on Wednesday. What is the average number of hours she danced each day? Round your answer to the nearest tenth of an hour.

99. Jackie makes $15.25/hour babysitting. George makes $18.50/hour mowing the lawn. If Jackie babysits for 4 hours and George mows lawns for 3 hours, who makes more money? How much more does he/she make?

100. A box of 8 crayons costs $0.96. How much does each crayon cost? At that unit price, how much would a box of 30 crayons cost?

Answer Key

Evaluate each expression.

1. $5.983 + 2.99$ 8.973	2. $224 - 56.73$ 167.27	3. $6.12 - 4.923$ 1.197
4. $24.5 \cdot 3.2$ 78.4	5. $0.23 \cdot 7$ 1.61	6. $3.86 \cdot 9.15$ 35.319
7. $14.8 \div 5$ 2.96	8. $46.3 \div 1.5$ $30.8\overline{6}$	9. $147 \div 2.25$ $65.\overline{3}$
10. $24.33 - 2.5 \cdot 7$ 6.83	11. $3.9 + 4.5^2$ 24.15	12. $9.25(18.4 - 2 \cdot 1.2)$ 148

Solve each word problem, showing all work.

13. Jeff had \$46.18 in his wallet Monday morning. He gave half of his money to his brother. He then bought two donuts for \$0.75 each and a cup of coffee for \$2.99. How much money did Jeff have left? \$18.60	14. Five friends split a \$65.20 bill at a restaurant. They also each left \$2.75 for the tip. How much money did each person pay in all? \$15.79

Answer Key

Evaluate each expression.

15. $\frac{4}{5} + \frac{3}{4}$ $1\frac{11}{20}$	16. $4\frac{2}{7} + 2\frac{9}{14}$ $6\frac{13}{14}$	17. $8\frac{11}{12} + 9\frac{5}{18}$ $18\frac{7}{36}$
18. $6 - \frac{3}{8}$ $5\frac{5}{8}$	19. $8\frac{3}{5} - 2\frac{1}{3}$ $6\frac{4}{15}$	20. $4\frac{1}{6} - \frac{8}{9}$ $3\frac{5}{18}$
21. $\frac{4}{25} \cdot \frac{15}{16}$ $\frac{3}{20}$	22. $2\frac{3}{4} \cdot 8$ 22	23. $6\frac{5}{8} \cdot 3\frac{1}{2}$ $23\frac{3}{16}$
24. $\frac{7}{9} \div \frac{2}{3}$ $1\frac{1}{6}$	25. $\frac{4}{5} \div 10$ $\frac{2}{25}$	26. $5\frac{2}{3} \div 2\frac{5}{6}$ 2

Solve each word problem, showing all work.

27. Jaimie ran $3\frac{1}{2}$ miles on Monday. She ran half as far on Tuesday as she did on Monday. How far did Jaimie run in all on Monday and Tuesday? $5\frac{1}{4}$ miles	28. A $5\frac{1}{2}$ quart pot is filled $\frac{2}{3}$ of the way with water. How many more quarts of water can the pot hold? $1\frac{5}{6}$ quarts

Answer Key

Write each ratio in 3 ways.

29. A bank contains 15 pennies and 12 nickels. Write the ratio of nickels to pennies. 4:5, 4 to 5, $\frac{4}{5}$	30. A bowl contains 6 apples and some bananas. If there are a total of 10 pieces of fruit, find the ratio of apples to bananas. 3:2, 3 to 2, $\frac{3}{2}$

Convert each rate to a unit rate.

31. $4.25 for 64 fluid ounces $0.07 per floz	32. 297 miles on 11 gallons of gas 27 mi/gal	33. 124 feet in 10 seconds 12.4 ft/sec

Complete the chart by converting each number to a percent, fraction, and/or decimal.

Fraction	Decimal	Percent
34. $\frac{3}{8}$	0.375	37.5%
35. $\frac{9}{20}$	0.45	45%
36. $\frac{18}{25}$	0.72	72%
37. $\frac{1}{10}$	0.1	10%
38. $\frac{3}{200}$	0.015	1.5%

Find each percent of a number.

39. 30% of 90 27	40. 15% of 38 5.7	41. 50% of 86 43
42. 75% of 160 120	43. 24% of 35 8.4	44. 2% of 74 1.48

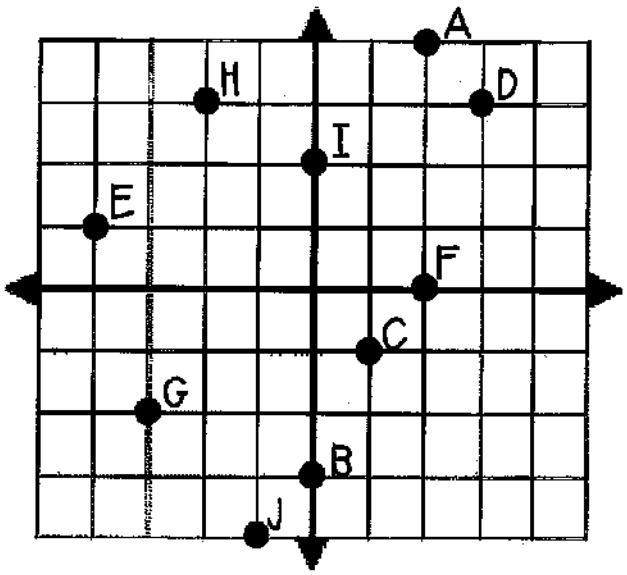
Answer Key

Compare the integers with <, >, or =.

45. $-4 \bigcirc -5$	46. $2 \bigcirc -2$	47. $\lvert -5\rvert \bigcirc \lvert 5\rvert$	48. $-7 \bigcirc 6$	49. $-13 \bigcirc -9$
50. $\lvert -7\rvert \bigcirc -6$	51. $-17 \bigcirc -14$	52. $\lvert -3\rvert \bigcirc \lvert -2\rvert$	53. $0 \bigcirc -6$	54. $\lvert -4\rvert \bigcirc \lvert 6\rvert$

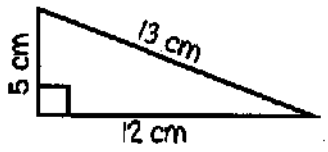
Graph and label each of the ordered pairs in the coordinate plane. Then state the quadrant or axis in/on which the point is located.

55. A(2, 4) Quadrant I	56. B(0, -3) y-axis
57. C(1, -1) Quadrant IV	58. D(3, 3) Quadrant I
59. E(-4, 1) Quadrant II	60. F(2, 0) x-axis
61. G(-3, -2) Quadrant III	62. H(-2, 3) Quadrant II
63. I(0, 2) y-axis	64. J(-1, -4) Quadrant III



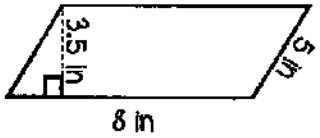
Find the perimeter, area, and/or volume of the given figure.

65. Find the perimeter & area:



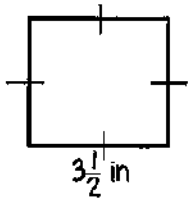
$P = 30$ cm
$A = 30$ cm^2

66. Find the perimeter & area:



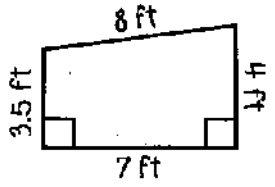
$P = 26$ in
$A = 28$ in^2

67. Find the perimeter & area:



$P = 14$ in
$A = 12\frac{1}{4}$ in^2

68. Find the perimeter & area:



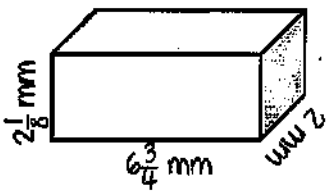
$P = 22.5$ ft
$A = 26.25$ ft^2

69. Find the area of a square with a perimeter of 45 cm

$A = 126\frac{9}{16}$ cm^2

(or 126.5625 cm^2)

70. Find the volume:



$V = 28\frac{11}{16}$ mm^3

Answer Key

Evaluate each expression for $a = 5$, $b = 12$, $c = 10$, & $d = 2$.

71. $2b - a$ 19	72. $d(ab - c)$ 100	73. $3 + \frac{b}{d}$ 9
74. $\frac{4a}{b + 4d}$ 1	75. $2a^2 - c$ 40	76. $b - c + d$ 4

Solve each one-step equation.

77. $g + 3 = 17$ $g = 14$	78. $r - 6 = 7$ $r = 13$	79. $6b = 18$ $b = 3$	80. $\frac{h}{9} = 3$ $h = 27$
81. $5 = f - 8$ $f = 13$	82. $48 = 12b$ $b = 4$	83. $a + 24 = 83$ $a = 59$	84. $17 + x = 23$ $x = 6$
85. $10 = \frac{m}{5}$ $m = 50$	86. $86.5 = f - 7.63$ $f = 94.13$	87. $\frac{n}{6} = 11$ $n = 66$	88. $\frac{3}{4}h = 12$ $h = 16$

Answer Key

Solve each word problem using the method of your choice.

89. A fencing company charges $22 per foot to install a wood fence. How much will it cost to install a wood fence around a rectangular pool area that is 20 feet wide and 38 feet long?

$2,552

90. A 6 inch-tall plant grew ¾ of an inch one week and twice as much the following week. How tall is the plant now?

$8\frac{1}{4}$ inches tall

91. Jack can read 45 pages of his book in one and a half hours. At that rate, how long will it take him to read the entire 300-page book?

10 hours

92. Brian ordered 3 large cheese pizzas and a salad. The salad cost $4.95. If he spent a total of $47.60 including the $5 tip, how much did each pizza cost? (Assume there is no tax).

$12.55

93. A cookie recipe calls for $3\frac{1}{4}$ cups of flour. The recipe makes 3 dozen cookies. How much four is needed to make 144 cookies?

13 cups of flour

94. Ella has a box of chocolate candies. She gives $\frac{1}{3}$ of the candies to her sister, 4 to her brother, and she eats the remaining 12 candies. How many chocolate candies were in the box originally?

24 chocolate candies

Answer Key

Solve each word problem using the method of your choice.

95. 20% of the 520 students in Wendover Middle School were involved in school sports. Of those students, 12.5% were on the wrestling team. How many students were on the wrestling team?

13 students

96. A piggy bank contains some dimes and nickels. There are 8 more dimes than nickels in the bank. There is a total of $1.40. How many of each type of coin are in the bank?

4 nickels & 12 dimes

97. An elevator in a tall building goes up 7 floors, then down 9 floors, down 4 floors, up 8 floors, and down 2 floors. Now it is on floor 14. On what floor did the elevator start?

the 14th floor

98. Jenna danced for 3 hours on Sunday, 2 hours on Monday and Tuesday, 1 hour on Thursday, 1.5 hours on Friday, and 2 hours on Saturday. She did not dance at all on Wednesday. What is the average number of hours she danced each day? Round your answer to the nearest tenth of an hour.

about 1.6 hours

99. Jackie makes $15.25/hour babysitting. George makes $18.50/hour mowing the lawn. If Jackie babysits for 4 hours and George mows lawns for 3 hours, who makes more money? How much more does he/she make?

Jackie makes $5.50 more than George.

100. A box of 8 crayons costs $0.96. How much does each crayon cost? At that unit price, how much would a box of 30 crayons cost?

$3.60

Name _____ Class _____ Date _____

CHAPTER 12 Introduction to Plants

SECTION 1

What Is a Plant?

California Science Standards

7.1.b, 7.1.d, 7.5.a

BEFORE YOU READ

After you read this section, you should be able to answer these questions:

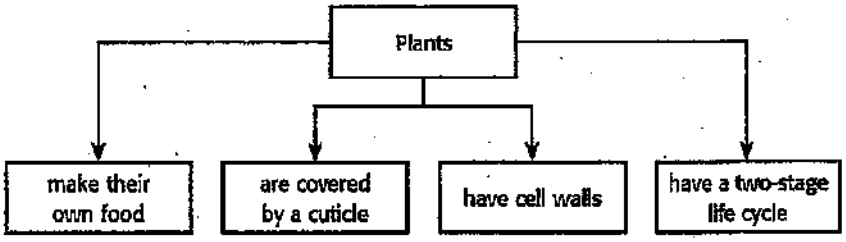
- What characteristics do all plants share?
- What are two differences between plant cells and animal cells?
- How are vascular plants different from nonvascular plants?

STUDY TIP

Organize As you read, make a diagram to show the major groups of plants. Be sure to include the characteristics of each group.

What Is a Plant?

A plant is an organism that uses sunlight to make food. Trees, grasses, ferns, cactuses, and dandelions are all types of plants. Plants can look very different, but they all share four characteristics.



MAKING THEIR OWN FOOD

Plants make food from carbon dioxide and water in a process called *photosynthesis*. Photosynthesis takes place in special organelles called *chloroplasts*. The process needs light energy. Inside the chloroplasts, a green pigment called *chlorophyll* collects energy from the sun for photosynthesis. Chlorophyll is what makes most plants look green. Animal cells do not have chloroplasts. ☑

READING CHECK

1. Define What is chlorophyll?

_____

_____

_____

_____

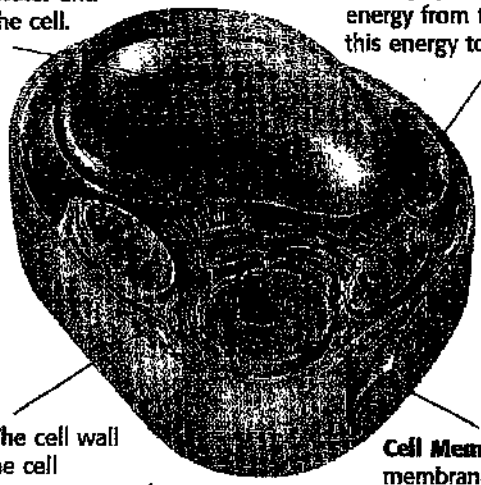
CUTICLE COVER

Every plant has a cuticle that covers and protects it. A *cuticle* is a waxy layer that coats a plant's leaves and stem. The cuticle keeps plants from drying out by keeping water inside the plant.

CELL WALLS

How do plants stay upright? They do not have skeletons, as many animals do. Instead, each plant cell is surrounded by a stiff cell wall. The cell wall is outside the cell membrane. Cell walls support and protect the plant cell. Animal cells do not have cell walls.

Structures in a Plant Cell



Large Central Vacuole A vacuole stores water and helps support the cell.

Chloroplast Chloroplasts contain chlorophyll. Chlorophyll captures energy from the sun. Plants use this energy to make food.

Cell Wall The cell wall surrounds the cell membrane. It supports and protects the plant cell.

Cell Membrane The cell membrane surrounds a plant cell and lies under the cell wall.

CALIFORNIA STANDARDS CHECK

7.1.b Students know the characteristics that distinguish plant cells from animal cells, including chloroplasts and cell walls.

Word Help: distinguish to show differences between two or more objects

2. Describe Name two structures found in plant cells but not in animal cells. Describe the function of each structure.

_____

_____

_____

_____

_____

TWO-STAGE LIFE CYCLE

Many organisms, including plants, produce offspring when a sperm joins with an egg. This is called *sexual reproduction*. In animals, sexual reproduction happens in every generation. However, plants do not produce sperm and eggs in every generation.

Plants have a two-stage life cycle. This means that they need two generations to produce eggs and sperm. In the *sporophyte* stage, a plant makes spores. A *spore* is a cell that can divide and grow into a new plant. This new plant is called a *gametophyte*. In the gametophyte stage, the plants produce sperm and eggs. The sperm and eggs then join to produce a new sporophyte. ☑

READING CHECK

3. List What are the two stages of the plant life cycle?

_____

_____

What Are the Main Groups of Plants?

There are two main groups of plants: vascular and non-vascular. A **vascular plant** has specialized vascular tissues. *Vascular tissues* move water and nutrients from one part of a plant to another. A **nonvascular plant** does not have vascular tissues to move water and nutrients.

NONVASCULAR PLANTS

Instead of special tissues to move water and nutrients, nonvascular plants depend on diffusion to move these materials. In *diffusion*, water and nutrients move through a cell membrane and into a cell. Diffusion works best over short distances. Each cell must get water and nutrients from the environment or a cell that is close by.

Nonvascular plants can rely on diffusion because they are small. If a nonvascular plant were large, not all of its cells would get enough water and nutrients. Most nonvascular plants live in damp areas, so each of their cells is close to water. ☑

READING CHECK

4. Identify How do water and nutrients move through a nonvascular plant?

_____

VASCULAR PLANTS

Critical Thinking

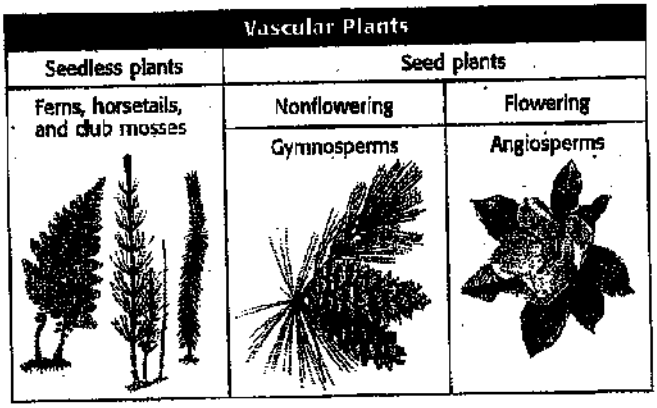
5. Apply Concepts Do you think a sunflower is a gymnosperm or an angiosperm? Explain your answer.

_____

_____

_____

Many of the plants we are most familiar with are vascular plants. They include ferns, pine trees, cactuses, and tulips. Vascular plants are divided into two groups: seedless plants and seed plants. Seed plants are divided into two more groups based on whether or not the plant has flowers. Nonflowering seed plants, such as pine trees, are called **gymnosperms**. Flowering seed plants, such as magnolias, are called **angiosperms**.



Name _____ Class _____ Date _____

Section 1 Review

7.1.b, 7.1.d, 7.5.a

SECTION VOCABULARY

angiosperm a flowering plant that produces seeds within a fruit

Word wise: The root *angio* means "vessel."

gymnosperm a vascular seed plant whose seeds are not enclosed by an ovary or fruit

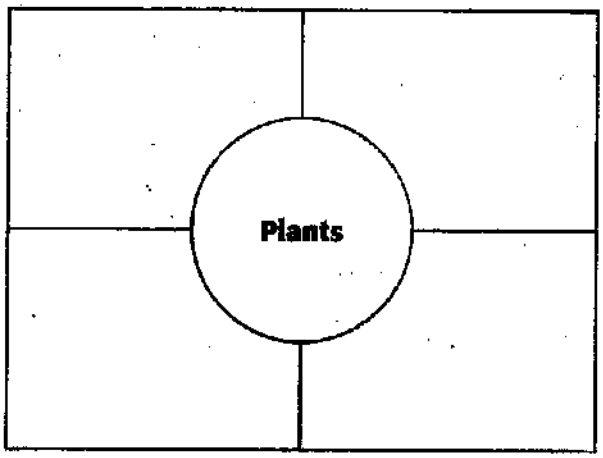
Word wise: The root *gymno* means "naked." The root *sperm* means "seed."

nonvascular plant a plant that lacks specialized conducting tissues and true roots, stems, and leaves

vascular plant a plant that has specialized tissues that conduct materials from one part of the plant to another

1. **Explain** What are the two main differences between a plant cell and an animal cell?

2. **Organize** Fill in each box in the figure below with one of the main characteristics of plants.



3. **Predict** What would happen to a plant if its chloroplasts stopped working? Explain your answer.

4. **Compare** What is the main difference between vascular and nonvascular plants?

Name _____ Class _____ Date _____

CHAPTER 12 Introduction to Plants

SECTION 2

Seedless Plants

California Science Standards

7.2.a, 7.5.a

BEFORE YOU READ

After you read this section, you should be able to answer these questions:

- What are the differences between seedless vascular plants and nonvascular plants?
- How do seedless vascular plants reproduce?
- How do nonvascular plants reproduce?

What Are Seedless Plants?

When you think of plants, you probably think of plants like flowers that make seeds, but many plants don't.

Remember that plants are divided into two main groups: nonvascular plants and vascular plants. All nonvascular plants are seedless, and some vascular plants are seedless, as well.

STUDY TIP

Organize As you read this section, make a chart that compares vascular plants and nonvascular plants.

Critical Thinking

1. Apply Concepts Why wouldn't you expect to see nonvascular plants in the desert?

_____

_____

_____

_____

What Are the Features of Nonvascular Plants?

Mosses, liverworts, and hornworts are types of nonvascular plants, which do not have vascular tissue. Instead, each cell gets water and nutrients directly from the environment or a nearby cell. Therefore, nonvascular plants usually live in damp places. They do not have true stems, roots, or leaves. However, they do have features that help them to get water and stay in place. A **rhizoid** is a rootlike structure that holds nonvascular plants in place. Rhizoids also help them get water and nutrients. ☑

READING CHECK

2. List What are two functions of the rhizoid?

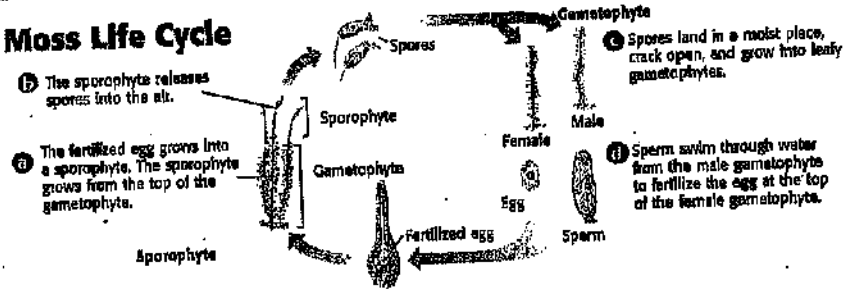
_____

_____

_____

Nonvascular plants
• have no vascular tissue
• have no true roots, stems, leaves, or seeds
• are usually small
• live in damp places

Moss Life Cycle



TAKE A LOOK

3. Identify Are the male and female gametophytes separate plants or part of the same plant?

_____

REPRODUCTION IN NONVASCULAR PLANTS

Like all plants, nonvascular plants have a two-stage life cycle. They have a sporophyte generation, which produces spores, and a gametophyte generation, which produces eggs and sperm. Nonvascular plants can also reproduce asexually, that is, without eggs and sperm.

IMPORTANCE OF NONVASCULAR PLANTS

Nonvascular plants are usually the first plants to live in a new environment, such as newly exposed rock. When these plants die, they break down and help form a thin layer of soil. Then, plants that need soil in order to grow can move into these areas.

Some nonvascular plants are important as food or nesting material for animals. A nonvascular plant called peat moss is important to humans. When it turns to peat, it can be burned as a fuel.

Critical Thinking

4. Apply Concepts What do you think is the reason that nonvascular plants can be the first plants to grow in a new environment?

_____

_____

_____

_____

What Are the Features of Seedless Vascular Plants?

Vascular plants have specialized tissues that deliver water and nutrients to all their cells. Therefore, seedless vascular plants are often larger than nonvascular plants. They do not have to live in places that are damp. ☑

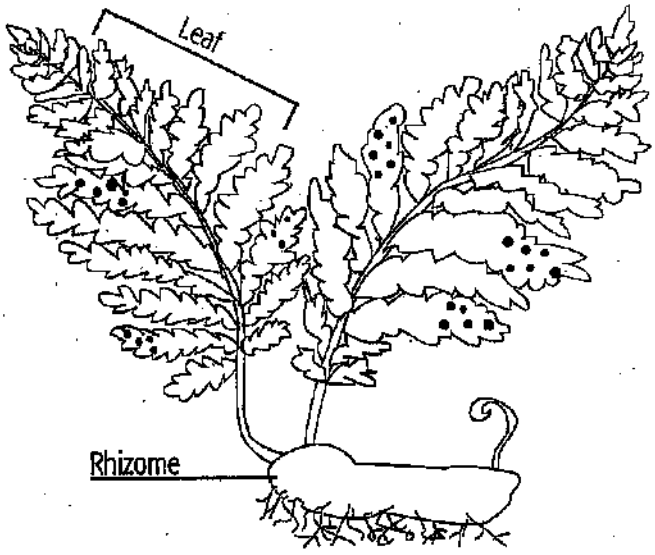
READING CHECK

5. Explain How do the cells of a seedless vascular plant get water?

_____

_____

Many seedless vascular plants, such as ferns, have a structure called a rhizome. The **rhizome** is an underground stem that produces new leaves and roots.



REPRODUCTION IN SEEDLESS VASCULAR PLANTS

Seedless vascular plants and nonvascular plants have very similar life cycles. First, the sperm from a male gametophyte joins with the egg from a female gametophyte. The sporophyte that grows from the egg and sperm produces spores. Then, these spores grow into new gametophytes.

Seedless vascular plants can also reproduce asexually. This can happen when new plants branch off from older plants. It can happen also when pieces of one plant fall off and begin to grow as new plants. ☑

READING CHECK

6. Describe What are two ways in which seedless nonvascular plants reproduce asexually?

_____

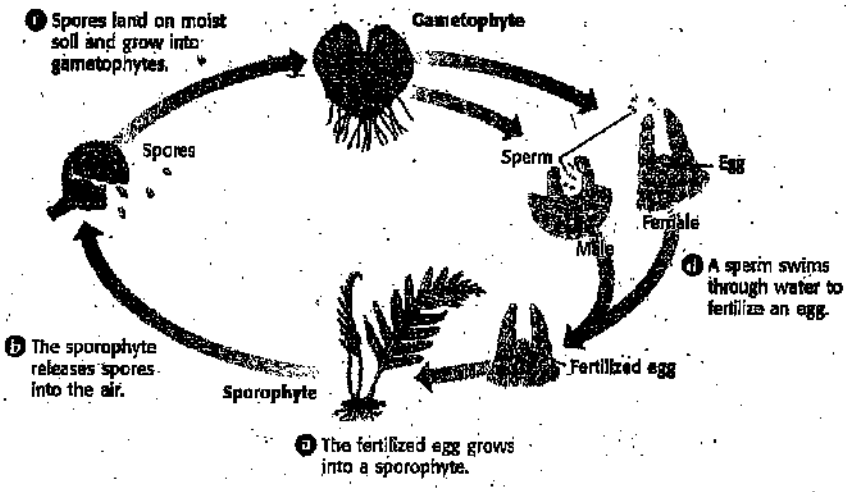
_____

_____

_____

_____

Fern Life Cycle



TAKE A LOOK

7. Apply Concepts Does this figure show sexual or asexual reproduction? Explain your answer.

_____

_____

_____

_____

IMPORTANCE OF SEEDLESS VASCULAR PLANTS

Seedless vascular plants that lived about 300 million years ago are important to people today. After these ancient ferns, horsetails, and club mosses died, they formed coal and oil. Coal and oil are fossil fuels that people remove from Earth's crust to use for energy. They are called *fossil fuels* because they formed from plants (or animals) that lived long ago. ☑

READING CHECK

8. Explain Where does coal come from?

_____

_____

_____

_____

_____

Seedless vascular plants help to make and preserve soil. Seedless vascular plants help form new soil when they die and break down. Their roots can make the soil deeper, which allows other plants to grow. Their roots also help prevent soil from washing away.

Many seedless vascular plants are used by humans. Ferns and some club mosses are popular houseplants. Horsetails are used in some shampoos and skincare products.

Name _____ Class _____ Date _____

Section 2 Review

7.2.a, 7.5.a

SECTION VOCABULARY

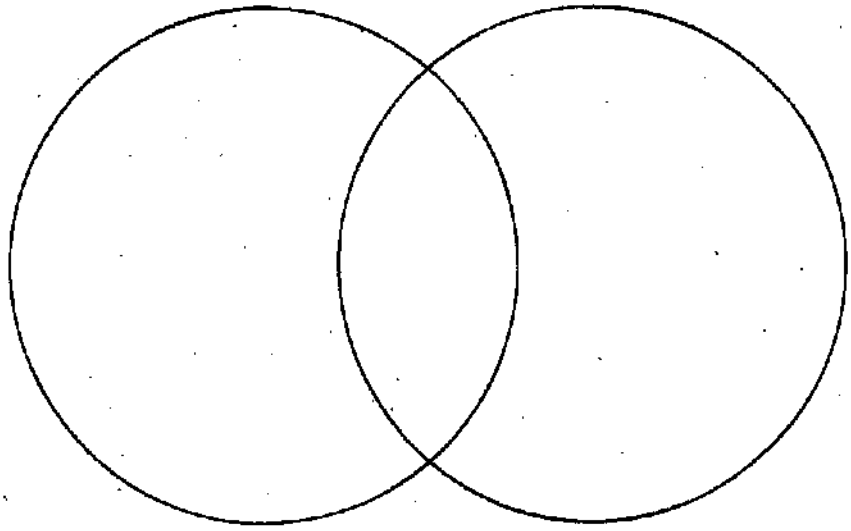
rhizoid a root-like structure in nonvascular plants that holds the plants in place and helps plants get water and nutrients

rhizome a horizontal, underground stem that produces new leaves, shoots, and roots

1. **Compare** What are two differences between a rhizoid and a rhizome?

2. **Explain** In which generation does sexual reproduction occur? Explain your answer.

3. **Compare** Use a Venn Diagram to compare vascular and nonvascular plants.



4. **Apply Concepts** Nonvascular plants are usually very small. How does their structure limit their size?

5. **List** Name six kinds of seedless plants.

Name _____ Class _____ Date _____

CHAPTER 12 Introduction to Plants

SECTION 3

Seed Plants

California Science Standards

7.2.a, 7.5.f

BEFORE YOU READ

After you read this section, you should be able to answer these questions:

- How are seed plants different from seedless plants?
- What are the parts of a seed?
- How do gymnosperms and angiosperms reproduce?

What Are Seed Plants?

STUDY TIP

List As you read this section, list the characteristics of gymnosperms and angiosperms.

Many of the plants you are most familiar with are seed plants. Seed plants include trees, such as oaks and pine trees, as well as flowers, such as roses and dandelions. Seed plants are one of the two main groups of vascular plants.

Like all plants, seed plants have a two-stage life cycle. However, seed plants differ from seedless plants, as shown below.

Seedless plants	Seed plants
They do not produce seeds.	They produce seeds.
The gametophyte grows as an independent plant.	The gametophyte lives inside the sporophyte.
Sperm need water to swim to the eggs.	Sperm are carried to the eggs by pollen.

READING CHECK

1. Explain Why can seed plants live in more habitats than seedless plants?

_____

_____

_____

Seed plants do not depend on moist habitats for reproduction, the way seedless plants do. Seed plants can live in many more places than seedless plants can. ☑

CALIFORNIA STANDARD CHECK

7.5.f Students know the structures and processes by which flowering plants generate pollen, ovules, seeds, and fruit.

Word Help: generate to bring about; to produce

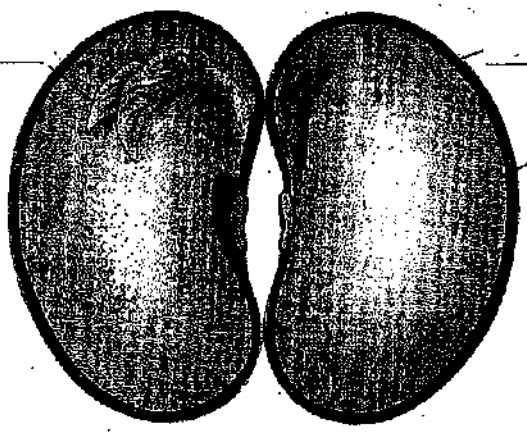
2. Identify What process must occur before a seed can develop?

_____

What Is a Seed?

A *seed* is a structure that feeds and protects a young plant. It forms after fertilization, when a sperm and an egg join. A seed has the following three main parts:

- a young plant, or sporophyte
- *cotyledons*, early leaves that provide food for the young plant
- a seed coat that covers and protects the young plant



A seed contains stored food and a young plant, or sporophyte. A seed is surrounded and protected by a seed coat.

ADVANTAGES OF HAVING SEEDS

Seeds give plants some advantages. For example, when the young plant inside a seed begins to grow, it uses the food stored in the seed. In contrast, the spores of seedless plants don't have stored food to help a new plant grow. Therefore, they will live only if they land in an area with enough resources.

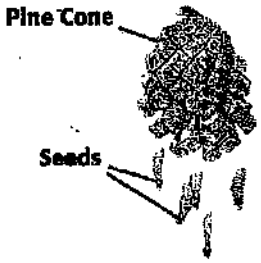
Another advantage is that seeds can be spread by animals. The spores of seedless plants are usually spread by wind. Animals often spread seeds more efficiently than the wind spreads spores. Therefore, seeds that are spread by animals are more likely to find a good place to grow.

What Kinds of Plants Have Seeds?

Seed plants are divided into two main groups: gymnosperms and angiosperms. *Gymnosperms* are non-flowering plants, and *angiosperms* are flowering plants.

GYMNOSPERMS

Gymnosperms are seed plants that do not have flowers or fruits. They include plants such as pine trees and redwood trees. Many gymnosperms are evergreen, which means that they keep their leaves all year. Gymnosperm seeds usually develop in a cone, like a pine cone. ☑



TAKE A LOOK

3. Label Label the parts of a seed with these terms: young plant, seed coat, cotyledon.

Critical Thinking

4. Apply Concepts It is helpful for seed plants to have a supply of food in the seed. What do you think is the reason?

_____

_____

_____

_____

READING CHECK

5. Identify What structure do gymnosperm seeds usually develop in?

_____

REPRODUCTION IN GYMNOSPERMS

The most well-known gymnosperms are the conifers. Conifers are evergreen trees and shrubs, such as pines, spruces, and firs, that make cones to reproduce. They have male cones and female cones. Spores in male cones develop into male gametophytes, and spores in female cones develop into female gametophytes. The gametophytes produce sperm and eggs.

A pollen grain contains the tiny male gametophyte. When the wind blows, it carries pollen from the male cones to the female cones. This movement of pollen to the female cones is called pollination. Pollination is part of sexual reproduction in plants. ☑

READING CHECK

6. Explain How is gymnosperm pollen carried from one plant to another?

_____

After pollination, sperm fertilize the eggs in the female cones. A fertilized egg develops into a new sporophyte inside a seed. Eventually, the seeds fall from the cone. If the conditions are right, the seeds will grow.

TAKE A LOOK

7. Explain Does this picture show an example of sexual or asexual reproduction? Explain.

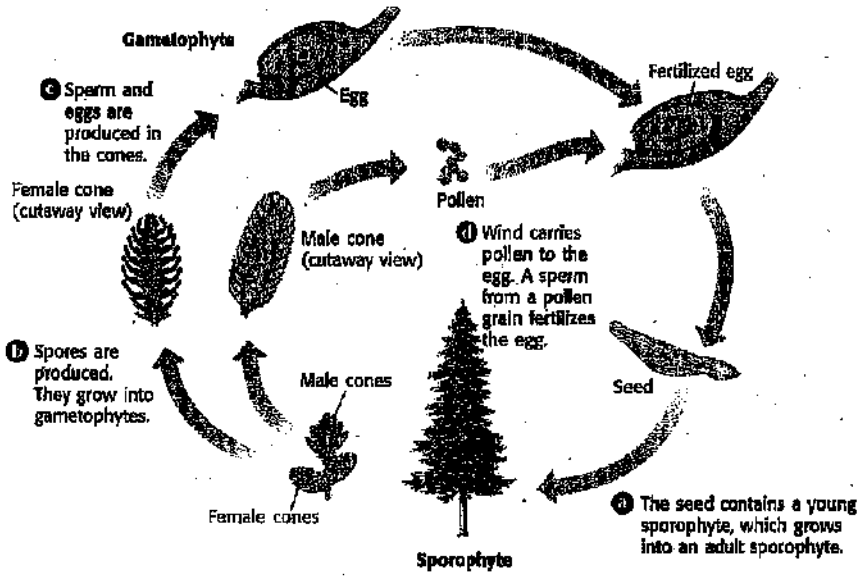
_____

_____

_____

_____

_____

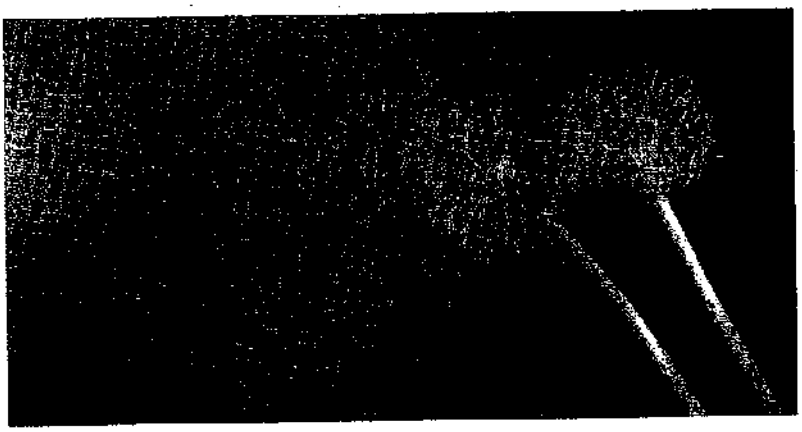


IMPORTANCE OF GYMNOSPERMS

Gymnosperms are used to make many products, such as medicines, building materials, and household products. Some conifers produce a drug used to fight cancer. Many trees are cut so that their wood can be used to build homes and furniture. Pine trees make a sticky substance called resin. Resin can be used to make soap, paint, and ink.

What Are Angiosperms?

Angiosperms are seed plants that produce flowers and fruit. Maple trees, daisies, and blackberries are all examples of angiosperms. There are more angiosperms on Earth than any other kind of plant. They can be found in almost every land ecosystem, including grasslands, deserts, and forests.



REPRODUCTION IN ANGIOSPERMS

In angiosperms, pollination takes place in flowers. Some angiosperms depend on the wind for pollination. Others rely on animals such as bees and birds to carry pollen from flower to flower.

Angiosperm seeds develop inside fruits. Some fruits and seeds, like those of a dandelion, are made to help the wind carry them. Other fruits, such as blackberries, attract animals that eat them. The animals drop the seeds in new places, where they can grow into plants. Some fruits, such as burrs, travel by sticking to animal fur. ☑

IMPORTANCE OF ANGIOSPERMS

Flowering plants provide food for animals. A mouse that eats seeds and berries uses flowering plants directly as food. An owl that eats a field mouse uses flowering plants indirectly as food. Flowering plants can also provide food for the animals that pollinate them.

People use flowering plants, too. Major food crops, such as corn, wheat, and rice, come from flowering plants. Many flowering trees, such as oak trees, can be used for building materials. Plants such as cotton and flax are used to make clothing and rope. Flowering plants are also used to make medicines, rubber, and perfume oils.

Math Focus

8. Calculate There are 300,000 species of angiosperms on Earth and 840 species of gymnosperms. What percentage of seed plants are angiosperms?

_____

READING CHECK

9. Identify Where do angiosperm seeds develop?

_____

Say It

Describe Think of all the products you used today that came from angiosperms. Describe to the class five items you used in some way and what kind of angiosperm they came from.

Name _____ Class _____ Date _____

Section 3 Review

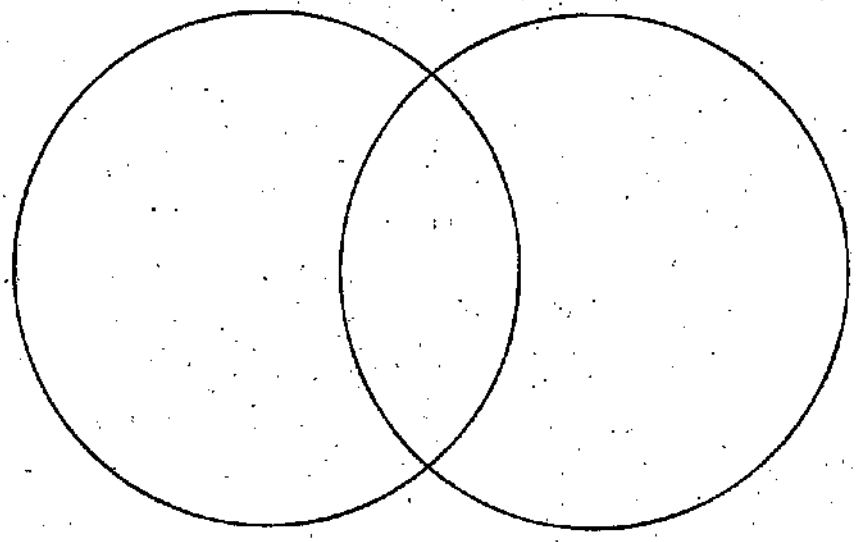
7.2.a, 7.5.f

SECTION VOCABULARY

1. **Compare** How are the gametophytes of seed plants different from the gametophytes of seedless plants?

2. **Describe** What happens during pollination?

3. **Compare** Use a Venn Diagram to compare gymnosperms and angiosperms.



4. **Identify** What two structures are unique to angiosperms?

5. **List** What are the three main parts of a seed? What does each part do?

Name _____ Class _____ Date _____

CHAPTER 12 Introduction to Plants

SECTION 4

Structures of Seed Plants

BEFORE YOU READ

After you read this section, you should be able to answer these questions:

- What are the functions of roots and stems?
- What is the function of leaves?
- What is the function of a flower?

California Science Standards

7.5.a, 7.5.f

What Are Seed Plants?

Remember that seed plants include trees, such as oaks and pine trees, as well as flowers, such as roses and dandelions. Seed plants are one of the two main groups of vascular plants.

STUDY TIP

List As you read this section, make a chart listing the structures of seed plants and their functions.

What Structures Are Found in a Seed Plant?

Just like the human body, a plant has different organs that do jobs for the organism. Seed plants have roots, shoots, and reproductive structures. A plant's roots and shoots help the plant to get water and nutrients. Roots are often found underground. Shoots include stems and leaves. They are usually found above ground. ☑

READING CHECK

1. Identify What are the three main parts of a seed plant?

_____

_____

_____

The roots of plants absorb and store water and nutrients.

CALIFORNIA STANDARDS CHECK

7.5.a Students know plants and animals have levels of organization for structure and function, including cells, tissues, organs, organ systems, and the whole organism.

Word Help: structure the way in which a whole is put together

2. Describe What are the functions of xylem and phloem?

_____

_____

_____

_____

_____

VASCULAR TISSUE

Like all vascular plants, seed plants have specialized tissues that move water and nutrients through the plant. There are two kinds of vascular tissue: xylem and phloem. **Xylem** moves water and minerals from the roots to the shoots. **Phloem** moves food molecules to all parts of the plant. The vascular tissues in the roots and shoots are connected.

What Are Roots?

Roots are organs that have three main functions:

- to absorb water and nutrients from the soil
- to hold plants in the soil
- to store extra food made in the leaves

Roots have several structures that help them do these jobs. The *epidermis* is a layer of cells that covers the outside of the root, like skin. Some cells of the epidermis, called *root hairs*, stick out from the root. These hairs increase the root's surface area. A larger surface area helps the root absorb more water and minerals. A *root cap* is a group of cells found at the tip of a root. The root cap protects the root as it grows down through the soil.

Critical Thinking

3. Apply Concepts What do you think happens to water and minerals right after they are absorbed by roots?

_____

_____

_____

TAKE A LOOK

4. Identify Where is the vascular tissue located in this root?

_____

_____

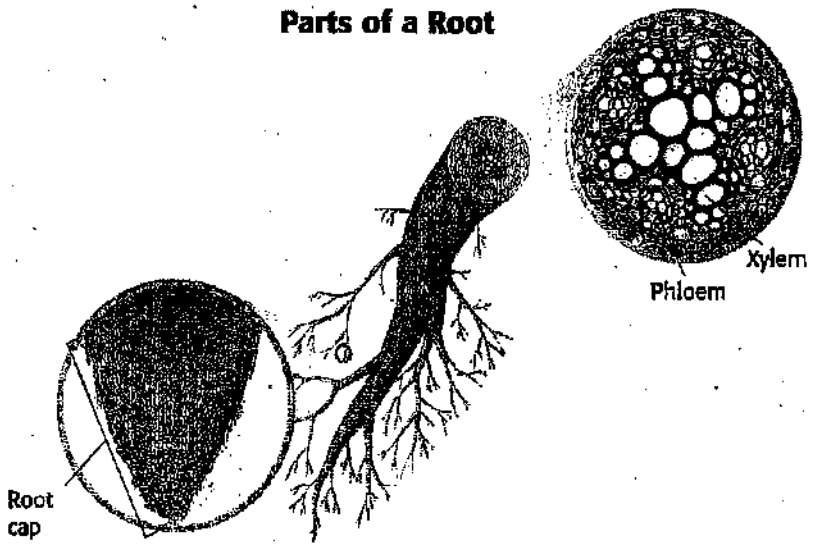
5. Apply Concepts How do you think food made in the leaves gets to the roots for storage?

_____

_____

_____

Parts of a Root



TYPES OF ROOT SYSTEMS

There are two kinds of root systems: taproot systems and fibrous root systems. A *taproot system* has one main root, or taproot, that grows downward. Many smaller roots branch from the taproot. Taproots can reach water deep underground. Carrots are plants that have taproot systems.

A *fibrous root system* has several roots that spread out from the base of a plant's stem. The roots are usually the same size. Fibrous roots usually get water from close to the soil surface. Many grasses have fibrous root systems.

What Are Stems?

A stem is an organ that connects a plant's roots to its leaves and reproductive structures. A stem does the following jobs: ☑

- Stems support the plant body. Leaves are arranged along stems so that each leaf can get sunlight.
- Stems hold up reproductive structures such as flowers. This helps bees and other pollinators find the flowers.
- Stems carry materials between the root system and the leaves and reproductive structures. Xylem carries water and minerals from the roots to the rest of the plant. Phloem carries the food made in the leaves to roots and other parts of the plant.
- Some stems store materials. For example, the stems of cactuses can store water.

READING CHECK

6. Define What is a stem?

_____

_____

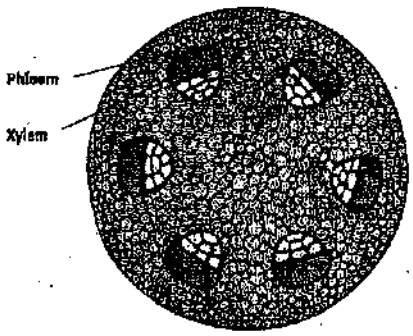
_____

_____

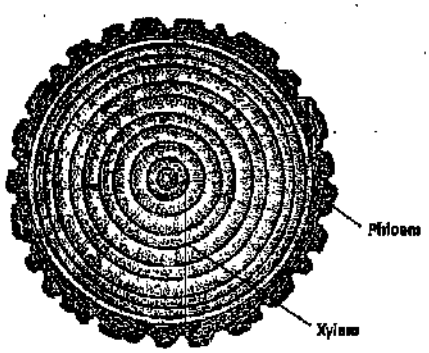
TYPES OF PLANT STEMS

There are two different types of stems: herbaceous and woody. *Herbaceous* stems are soft and flexible. Flowers, such as daisies and clover, have herbaceous stems. Many crops, such as tomatoes, corn, and beans, also have herbaceous stems.

Other plants have woody stems. *Woody* stems are stiff and are often covered by bark. Trees and shrubs have woody stems. The trunk of a tree is actually its stem!



Herbaceous stems are thin and flexible.



Woody stems are usually thick and stiff.

TAKE A LOOK

7. Compare How are these stems similar?

_____

_____

8. Compare How are these stems different?

_____

_____

_____

What Are Leaves?

Leaves are organs, too. Photosynthesis happens in leaves. Leaves absorb carbon dioxide from the air. Chloroplasts in leaf cells capture energy from sunlight. The leaves use the energy, carbon dioxide, and water to make food. ☑

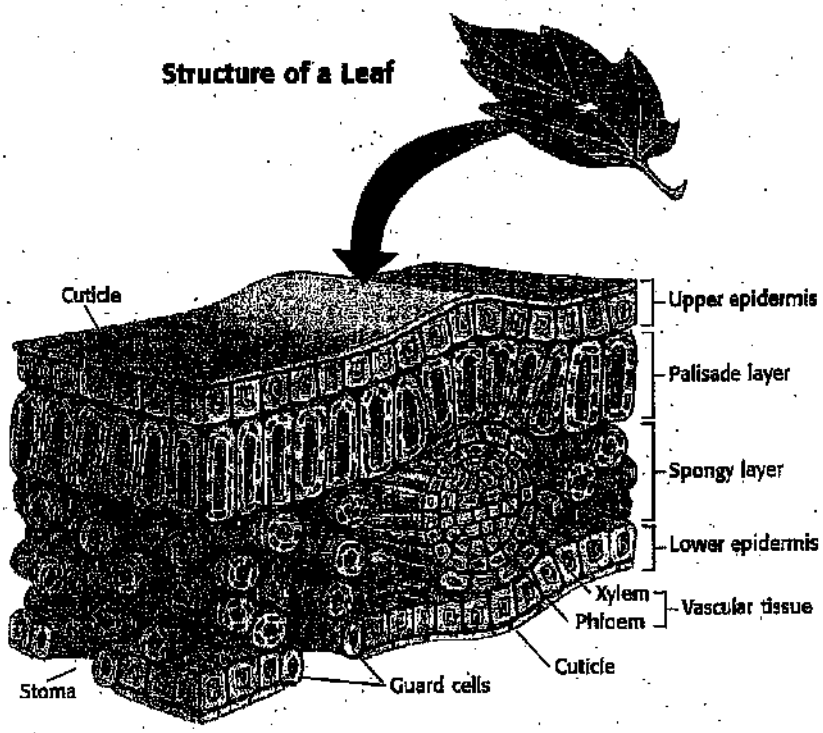
READING CHECK

9. Identify What is the main function of a leaf?

_____

All leaf structures are related to the leaf's main job, photosynthesis. A *cuticle* covers the surfaces of the leaf. It prevents the leaf from losing water. The *epidermis* is a single layer of cells beneath the cuticle. Tiny openings in the epidermis, called *stomata* (singular, *stoma*), let carbon dioxide enter the leaf. *Guard cells* open and close the stomata.

Structure of a Leaf



TAKE A LOOK

10. Explain Is this plant vascular or nonvascular? Explain your answer.

_____

_____

_____

Most photosynthesis takes place in the two layers in the middle of the leaf. The upper layer, called the *palisade layer*, contains many chloroplasts. Sunlight is captured in this layer. The lower layer, called the *spongy layer*, has spaces between the cells, where carbon dioxide can move. The spongy layer also has the vascular tissues that bring water to the leaves and move food away.

READING CHECK

11. Identify For what group of plants are flowers the reproductive structures?

_____

What Are Flowers?

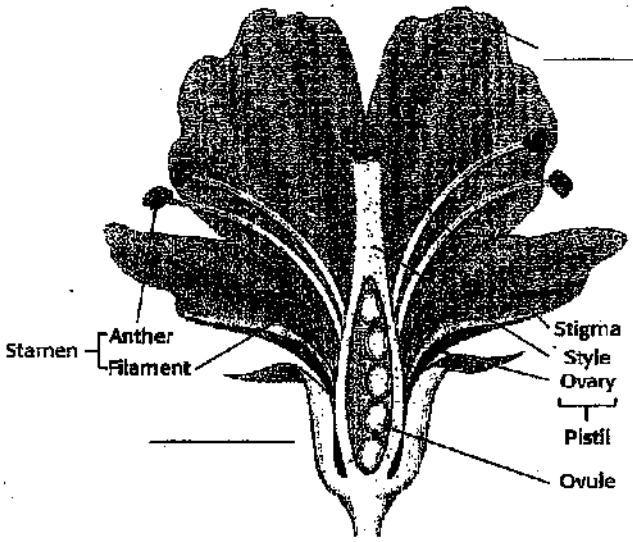
All plants have reproductive structures. In angiosperms, or flowering plants, flowers are the reproductive structures. Flowers produce eggs and sperm for sexual reproduction. ☑

PARTS OF A FLOWER

Flowers may have the following basic parts: sepals, petals, stamens, and one or more pistils. These parts are often arranged in rings, one inside the other. However, not all flowers have every part.

Different species of flowering plants can have different flower types. Flowers with all four parts are called *perfect flowers*. Flowers that have stamens but no pistils are male. Flowers that have pistils but no stamens are female.

Parts of a Flower



TAKE A LOOK

12. Label As you read, fill in the missing labels on the diagram.

13. Identify What two parts make up the stamen ?

_____

_____

14. Identify What three parts make up the pistil?

_____

_____

_____

SEPALS

Sepals are leaves that make up the outer ring of flower parts. They are often green like leaves, but they may have other colors. Sepals protect and cover the flower while it is still a bud. When the flower begins to open, the sepals fold back, so the petals can be seen.

PETALS

Petals are leaflike parts of a flower. They make up the next ring inside of the sepals. Petals are sometimes brightly colored, like the petals of poppy flowers or roses. This color helps attract insects and other animals. Many plants need these animals to help spread their pollen.

STAMENS

A **stamen** is the male reproductive structure of a flower. Structures on the stamen called *anthers* produce pollen. Pollen contains the male gametophyte, which produces sperm. The anther rests on a thin stalk called a *filament.* ☑

READING CHECK

15. Identify What is the male reproductive structure of a flower?

_____

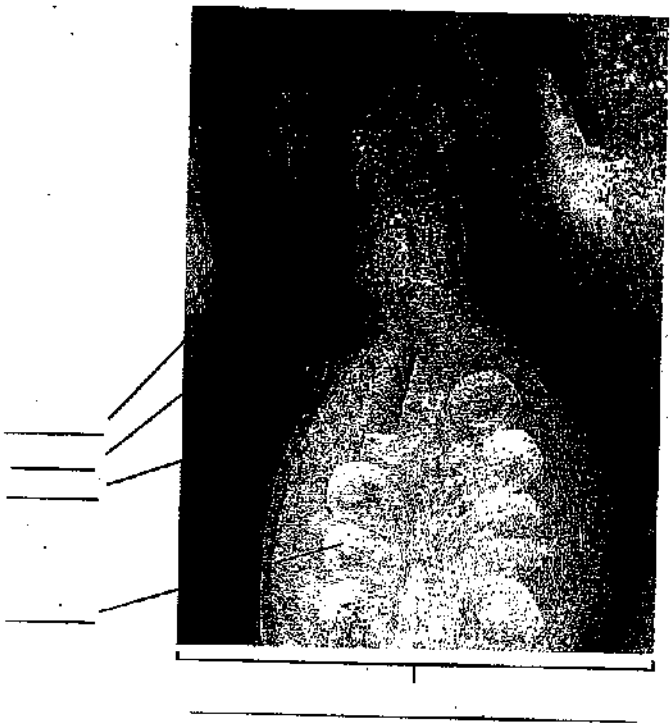
PISTILS

A pistil is the female reproductive structure. The tip of the pistil is called the *stigma*. The long, thin part of the pistil is called the *style*. The rounded base of the pistil is called the ovary. The ovary contains one or more ovules. Each ovule contains an egg. ☑

READING CHECK

16. Identify What is the female reproductive structure of a flower?

_____



TAKE A LOOK

17. Label Label the female reproductive structures in this picture.

Pollen is brushed onto the style, and sperm from inside the pollen travel down the style to the ovary. A sperm can fertilize the egg of one ovule. After fertilization, an ovule develops into a seed. The ovary surrounding the ovule develops into a fruit.

Say It

Discuss What is your favorite flower? Have you ever seen any unusual flowers in nature? In groups of two or three, discuss your experiences with flowers.

IMPORTANCE OF FLOWERS

Flowers are important to plants because they help plants reproduce. They are also important to animals, such as insects and bats, that use parts of flowers for food. Humans also use flowers. Some flowers, such as broccoli and cauliflower, can be eaten. Others, like chamomile, are used to make tea. Flowers are also used in perfumes, lotions, and shampoos.

Name _____ Class _____ Date _____

Section 4 Review

7.5.a, 7.5.f

SECTION VOCABULARY

ovary in flowering plants, the lower part of a pistil that produces eggs in ovules

ovule a structure in the ovary of a seed plant that contains an embryo sac and that develops into a seed after fertilization

petal one of the usually brightly colored, leaf-shaped parts that make up one of the rings of a flower

phloem the tissue that conducts food in vascular plants

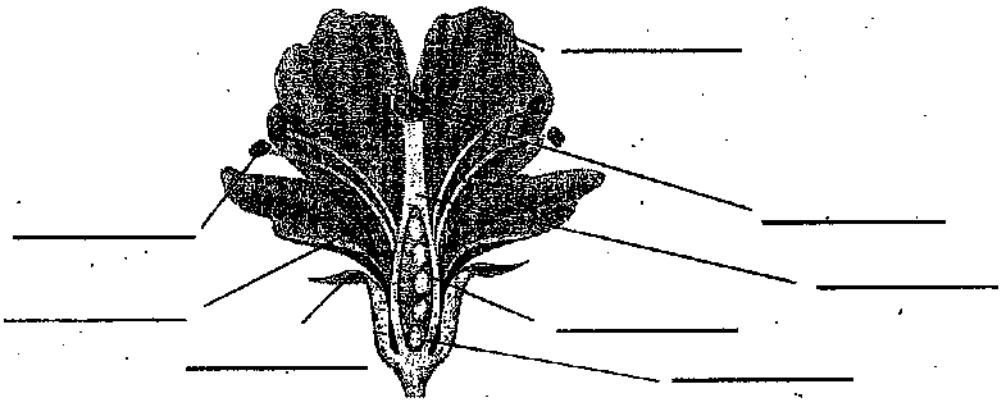
pistil the female reproductive part of a flower that produces seeds and consists of an ovary, style, and stigma

sepal in a flower, one of the outermost rings of modified leaves that protect the flower bud

stamen the male reproductive structure of a flower that produces pollen and consists of an anther and the tip of a filament

xylem the type of tissue in vascular plants that provides support and conducts water and nutrients from the roots

1. Label Label the parts of this perfect flower.



2. Compare How do taproot and fibrous root systems differ?

_____

_____

_____

3. Describe What are the three functions of a stem?

_____

_____

_____

4. List What are the four main organs of a flowering seed plant?

_____

Name _____ Class _____ Date _____

CHAPTER 13 Plant Processes

SECTION 1

Photosynthesis

California Science Standards
7.1.b, 7.1.d

BEFORE YOU READ

After you read this section, you should be able to answer these questions:

- How do plants make food?
- How do plants get energy from food?
- How do plants exchange gases with the environment?

STUDY TIP

Outline As you read, outline the steps of photosynthesis. Use the questions in the section titles to help you make your outline.

What Is Photosynthesis?

Many organisms, including humans, have to eat to get energy. Plants, however, are able to make their own food. Plants make their food by a process called **photosynthesis**. During photosynthesis, plants use carbon dioxide, water, and energy from sunlight to make sugars.

How Do Plants Use Sunlight for Photosynthesis?

Plant cells have organelles called *chloroplasts*. Chloroplasts capture the energy from sunlight. Inside a chloroplast, membranes called *grana* contain chlorophyll. **Chlorophyll** is a green pigment that absorbs light energy. Many plants look green because chlorophyll reflects the green wavelengths of light. ☑

READING CHECK

1. **Define** What is chlorophyll?

_____

_____

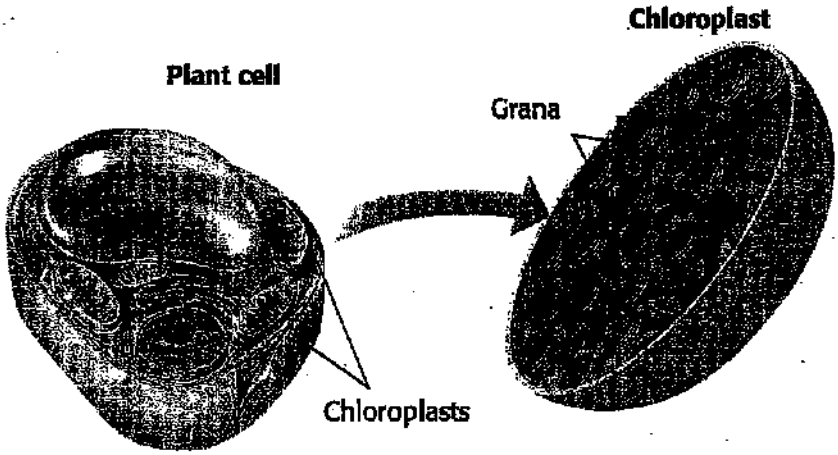
_____

TAKE A LOOK

2. **Identify** Where is chlorophyll found in a plant cell?

_____

_____



The grana in chloroplasts contain chlorophyll. Chlorophyll is a pigment that absorbs sunlight.

How Do Plants Make Sugar?

During photosynthesis, plants take in water and carbon dioxide and absorb light energy. Plants use the light energy captured by chlorophyll to help form glucose molecules. *Glucose* is the sugar that plants use for food. In addition to producing sugar, plants give off oxygen during photosynthesis. ☑

The following chemical equation summarizes photosynthesis:

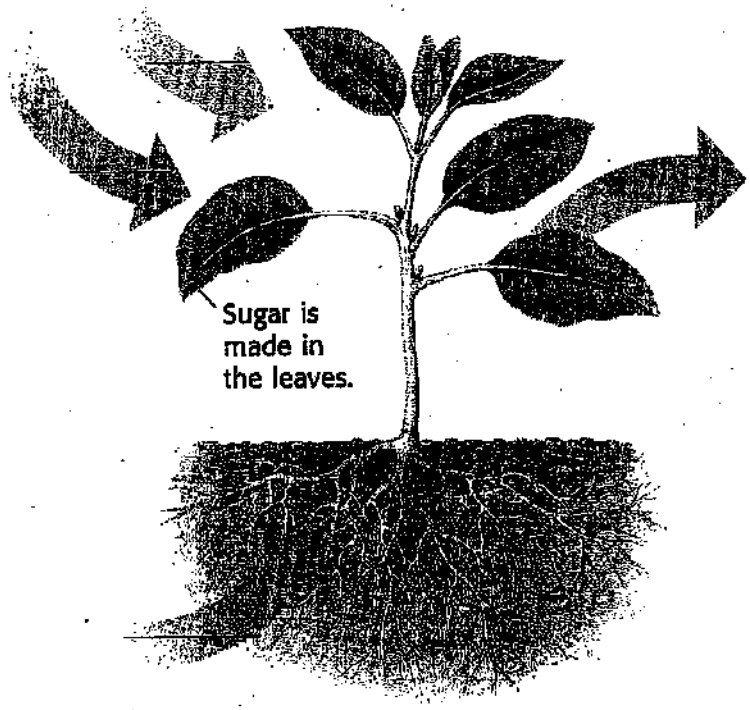
$$6CO_2 \text{ (carbon dioxide)} + 2H_2O \text{ (water)} \xrightarrow{\text{light energy}} C_6H_{12}O_6 \text{ (glucose)} + 6O_2 \text{ (oxygen)}$$

READING CHECK

3. Identify What are two products of photosynthesis?

_____

_____



TAKE A LOOK

4. Label On the diagram, label the arrows to show what materials are entering and leaving the plant during photosynthesis.

How Do Plants Get Energy from Sugar?

Glucose molecules store energy. To use this energy, a plant cell needs its mitochondria to break down the glucose. This process of breaking down food molecules to get energy is called **cellular respiration**. During cellular respiration, cells use oxygen to break down food molecules. Like all cells, plant cells then use the energy from food to do work.

CALIFORNIA STANDARDS CHECK

7.1.d Students know that mitochondria liberate energy for the work that cells do and that chloroplasts capture sunlight energy for photosynthesis.

Word Help: liberate to release; to set free

5. Identify Which cell structures release the energy stored in sugar?

_____

Critical Thinking

6. Predict What do you think would happen if a plant had no stomata?

_____

_____

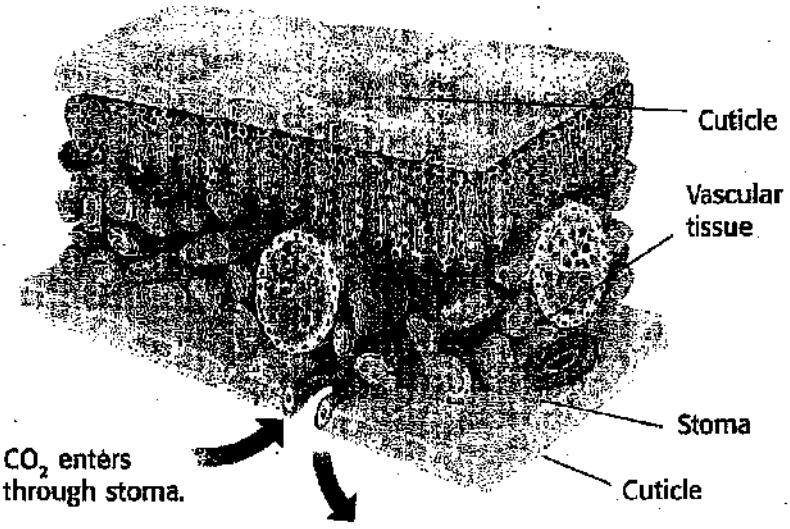
_____

_____

How Does a Plant Take In the Gases It Needs?

Plants take in carbon dioxide and give off oxygen. These gases move into and out of the leaf through openings called **stomata** (singular, *stoma*). Stomata allow gases to move through the plant's *cuticle*, the waxy layer that prevents water loss. Each stoma is surrounded by two guard cells. The guard cells act like double doors by opening and closing a stoma.

Water vapor also moves out of the leaf through stomata. The loss of water from leaves is called **transpiration**. Stomata open to allow carbon dioxide to enter a leaf but can close to prevent too much water loss.



TAKE A LOOK

7. Identify Circle the guard cells in this picture. What is their function?

_____

_____

Say It

Describe Think of all the ways in which photosynthesis is important to you. Describe to the class three ways you depend on photosynthesis.

READING CHECK

8. Complete During photosynthesis, plants store light energy as

_____

_____

Why Is Photosynthesis Important?

Plants and other photosynthetic organisms, such as bacteria and many protists, form the base of most food chains on Earth. During photosynthesis, plants store light energy as chemical energy. Animals get this energy when they eat plants. Other animals get energy from plants indirectly. They eat the animals that eat plants. Most organisms could not survive without photosynthetic organisms. ☑

Photosynthesis is also important because it produces oxygen. Recall that cellular respiration requires oxygen to break down food. Most organisms, including plants and animals, depend on cellular respiration to get energy from their food. Without the oxygen produced during photosynthesis, most organisms could not survive.

Name _____ Class _____ Date _____

Section 1 Review

7.1.b, 7.1.d

SECTION VOCABULARY

cellular respiration the process by which cells use oxygen to produce energy from food

chlorophyll a green pigment that captures light energy in photosynthesis

photosynthesis the process by which plants, algae, and some bacteria use sunlight, carbon dioxide, and water to make food

stoma one of many openings in a leaf or a stem of a plant that enable gas exchange to occur (plural: stomata)

transpiration the process by which plants release water vapor into the air through stomata; also the release of water vapor into the air by other organisms

1. **Explain** Why does chlorophyll look green?

2. **Identify** What is the role of mitochondria in plants? In what process do they take part?

3. **Compare** Complete the chart below to show the relationship between photosynthesis and cellular respiration.

Photosynthesis	Cellular respiration
	Cells break down food to provide energy.
Oxygen is produced.	

4. **Identify** What two structures in plant leaves help prevent the loss of water?

5. **Explain** Why are photosynthetic organisms, such as plants, so important to life on Earth?

Name _____ Class _____ Date _____

CHAPTER 13 Plant Processes

SECTION 2

Reproduction of Flowering Plants

California Science Standards

7.2.a, 7.5.f

BEFORE YOU READ

After you read this section, you should be able to answer these questions:

- What are pollination and fertilization?
- How do seeds and fruits form?
- How can flowering plants reproduce asexually?

What Are Pollination and Fertilization?

STUDY TIP

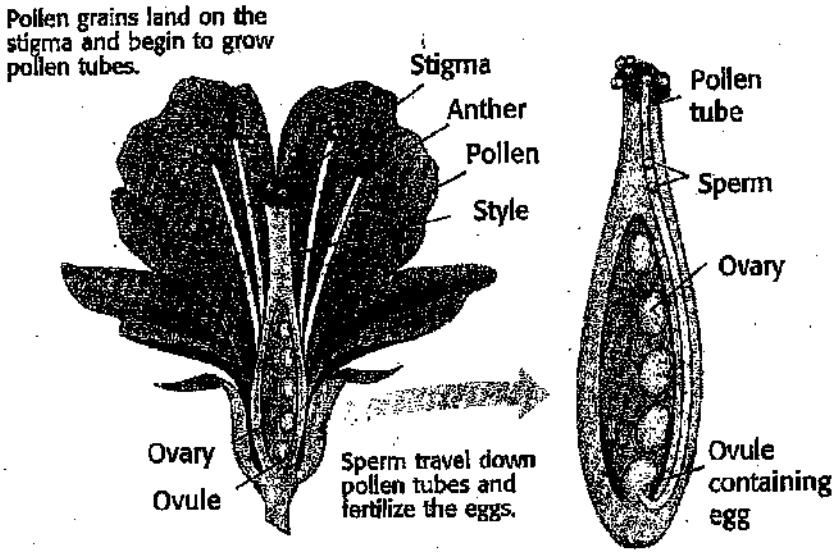
Summarize As you read, write out or draw the steps of pollination and fertilization.

Flowering plants are most obvious to us when they are in bloom. As flowers bloom, they surround us with bright colors and sweet fragrances. However, flowers are not just for us to enjoy. They are the structures for sexual reproduction in flowering plants. Pollination and fertilization take place in flowers.

TAKE A LOOK

1. **Identify** Circle the part of the flower where pollination occurs.

2. **Identify** Draw an arrow to show where fertilization will take place.



CALIFORNIA STANDARDS CHECK

7.2.a Students know the difference between the life cycles and reproduction methods of sexual and asexual organisms.

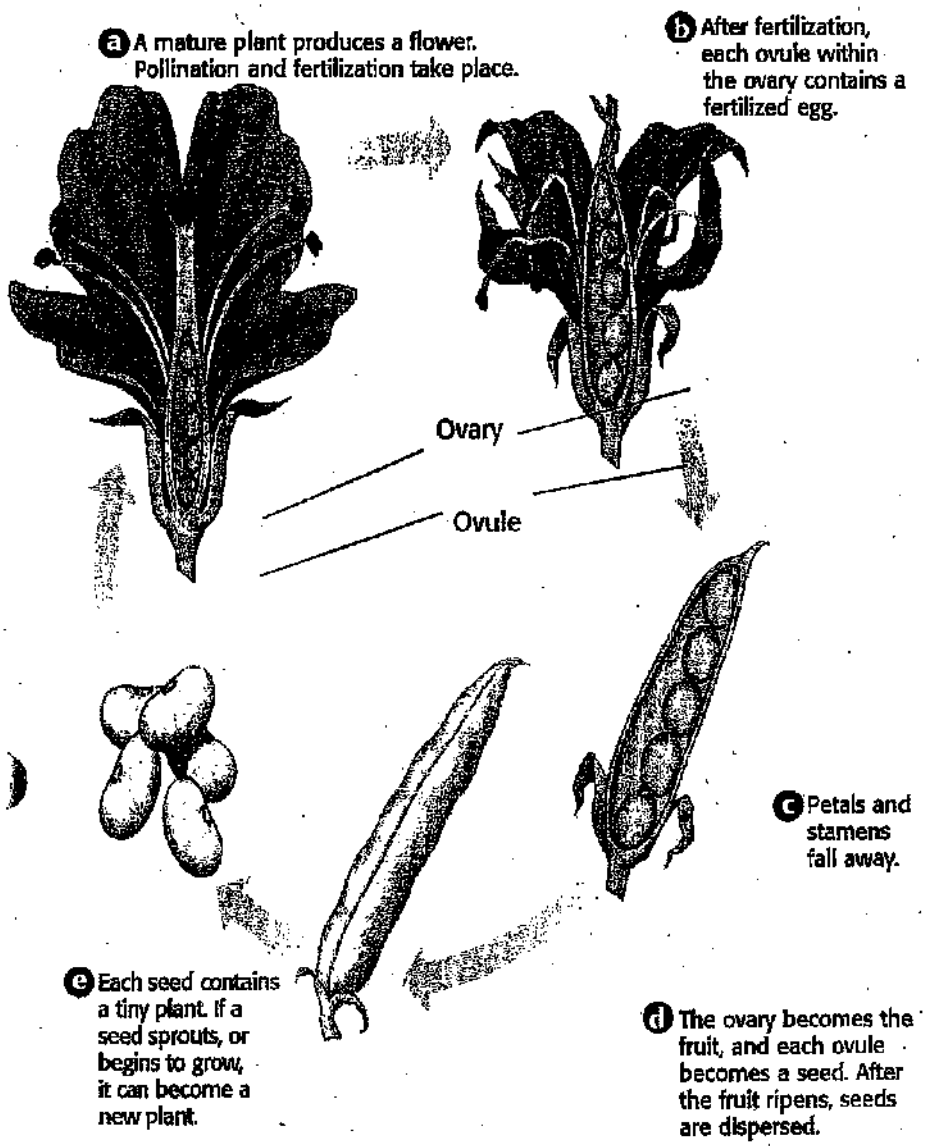
3. **Explain** Is fertilization a part of sexual reproduction or asexual reproduction? Explain.

_____

_____

Sexual reproduction begins in flowers when wind or animals move pollen from one flower to another. *Pollination* occurs when pollen from an anther lands on a stigma. Each pollen grain grows a tube through the style to the ovary. The ovary has ovules, each of which contains an egg. *Fertilization* occurs when a sperm joins with the egg inside an ovule.

What Happens After Fertilization?



TAKE A LOOK

4. Identify In step C, circle the structures that will become seeds.

CALIFORNIA STANDARDS CHECK

7.5.e Students know the structures and processes by which flowering plants generate pollen, ovules, seeds, and fruit.

Word Help: processes
a set of steps, events, or changes

5. Explain Where do seeds and fruits come from?

_____

_____

_____

_____

_____

THE FUNCTIONS OF FRUITS

When people think of fruit, they often think of apples or bananas. However, many things we call vegetables, such as tomatoes or green beans, are also fruits! A fruit is the ovary of the flower that has grown larger.

Fruits have two major functions. They protect seeds while the seeds develop. Fruits also help a plant spread its seeds to new environments. For example, an animal might eat a fruit and drop the seeds away from the parent plant. Fruits such as burrs spread when they get caught in an animal's fur. Other fruits are carried to new places by the wind, or even by water. ☑

READING CHECK

6. List What are two functions of a fruit?

_____

_____

_____

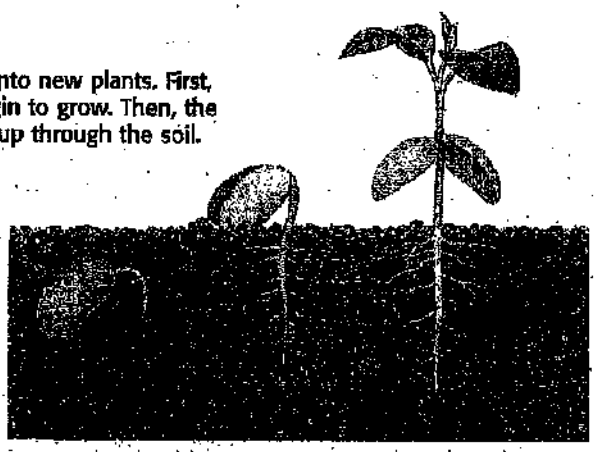
How Do Seeds Grow into New Plants?

The new plant inside a seed, called the *embryo*, stops growing once the seed is fully developed. However, the seed might not sprout right away. To sprout, most seeds need water, air, and warm temperatures. A seed might become **dormant**, or inactive, if the conditions are not right for a new plant to grow. For example, if the environment were too cold or too dry, a young plant would not survive. ☑

Dormant seeds often survive for long periods of time during droughts or freezing weather. Some seeds actually need extreme conditions, such as cold winters or forest fires, to *germinate*, or sprout.

☑ READING CHECK

7. Explain Why would a seed become dormant?



Seeds grow into new plants. First, the roots begin to grow. Then, the shoots grow up through the soil.

TAKE A LOOK

8. Identify Which part of a new plant grows first?

How Else Can Flowering Plants Reproduce?

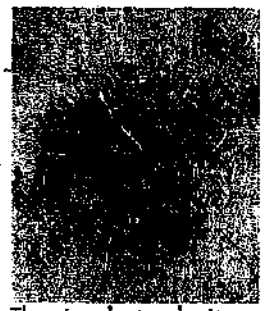
Flowering plants can also reproduce asexually, or without flowers. In asexual reproduction, sperm and eggs do not join. A new plant grows from a plant part such as a root or stem. These plant parts include plantlets, tubers, and runners.

Critical Thinking

9. Infer When would asexual reproduction be important for the survival of a flowering plant?

Kalanchoe produces plantlets along the edges of its leaves. The plantlets will fall off and take root in the soil.

A potato is a tuber, or underground stem. The "eyes" of potatoes are buds that can grow into new plants.



The strawberry plant produces runners, or stems that grow along the ground. Buds along the runners take root and grow into new plants.

Name _____ Class _____ Date _____

Section 2 Review

7.2.a, 7.5.f

SECTION VOCABULARY

dormant describes the inactive state of a seed or other plant part when conditions are unfavorable to growth	

1. **Compare** What is the difference between pollination and fertilization?

2. **Summarize** Complete the Process Chart below to summarize how sexual reproduction produces new plants.

A mature plant produces flowers.

↓

↓

↓

↓

Seeds are spread. They sprout and grow into new plants.

3. **Identify** Name two environmental conditions that can cause a seed to become dormant.

4. **List** What are three structures a flowering plant can use to reproduce asexually?

Name: _____

Date: _____ Per: _____

Write a Sentence With
COMMAS!

1. Write a sentence with a date and city and state. *(I was born on... in...)*

2. Write a sentence with a list of three things. *(I need....) (I'd wish for...)*

3. Write a sentence with two adjectives in a row.

4. Start a letter to the principal.

5. Write a sentence starting with a transition.

6. Write a sentence with an appositive.

7. Write a compound sentence.

8. Write a complex sentence.

NAME _____ CLASS _____ DATE _____

for CHAPTER 12: PUNCTUATION pages 768–75

Commas B

12f. Use commas to separate items in a series.

12g. Use commas to separate two or more adjectives that come before a noun.

12h. Use a comma before *and, but, for, nor, or, so,* or *yet* when it joins independent clauses in a compound sentence.

12i. Use commas to set off an expression that interrupts a sentence.

12j. Use a comma after certain introductory elements.

MECHANICS

EXERCISE Add commas where necessary in the following sentences. Hint: Some sentences need more than one comma.

Example 1. Before he went out onto the basketball court, Michael made sure his shoes were tied.

1. The four Beatles were John Lennon Paul McCartney George Harrison and Ringo Starr.
2. Sarah do you know Mr. Elway the minister of our church?
3. Carlo does not like cold weather yet he enjoys skiing.
4. The happy energetic girl ran to meet her grandfather.
5. In the backyard of our old house we taught our dog to roll over.
6. Oh I suppose you're right Sue.
7. After lunch Mr. Pradesh raked the leaves mowed the lawn and trimmed the bushes.
8. Is someone coming to pick you up or are you walking home?
9. The main ingredients of bread are flour yeast and water.
10. In the box on the top shelf of the closet Mom's old ice skates are packed in tissue paper.
11. The man on the left is Dr. Salter a local dentist.
12. At the first sign of spring I start digging my garden.
13. The crafts project calls for a pine cone glue and some glitter.
14. Sara is interested in zoology the study of animals.
15. The thick dark mud pulled at the ankles of the horses but the horses kept going.
16. In the summer of 2000 Alicia went to Spain.
17. The dog had thick brown hair and large floppy ears.
18. Mr. Allen had won the lottery yet he continued to do most of his shopping at garage sales.
19. After she took a long peaceful nap Kerri felt rested and alert.
20. After the long cold winter we were thrilled when spring arrived.

Commas with Interrupters

12i. Use commas to set off an expression that interrupts a sentence.

(1) Use commas to set off appositives and appositive phrases that are not necessary to the meaning of a sentence.
(2) Use commas to set off words used in direct address.

EXAMPLES The first-place winner, Ricardo, can enter the finals.
Spaghetti, a thin pasta, can be served with different sauces.
Did you say, Mrs. Herbert, that you need a baby sitter?
Ted, will you take care of Dylan on Saturday?

EXERCISE A Each of the following sentences contains at least one error in the punctuation of an appositive or an appositive phrase. Add commas to correct each error.

Example 1. Mr. Addison, our teacher, comes from Chicago.

1. The Jolly Tiger my father's favorite restaurant has a special this week on sandwiches.
2. I saw a special on television last night about cartography the science of mapmaking.
3. The organizers of the field trip Maya and Brenda prepared a guidebook for the class.
4. Have you met Dr. Santini our guest of honor?
5. Brendan a science fiction fan wrote a report about his favorite film.
6. I finally found a can of tomato sauce the last necessary ingredient for the recipe.
7. Whiskers our cat is fond of sleeping under the bed.
8. The story the funniest one I've read in a long time was the last one in the book.
9. The movie's music was written by Bernard Herrmann a well-known film composer.
10. A nutritionist Mr. Unruh will talk to us later about a balanced diet.

EXERCISE B Add commas as necessary in the following sentences.

Example 1. Tom, will you bring me that wrench, please?

11. Tell me Dr. Morituri how long have you lived in San Francisco?
12. Carla are you finished reading the newspaper yet?
13. Ask your mother's permission before you turn on the television Nicoletta.
14. Try not to drop the ball next time Ernesto.
15. If you bring the plates Nedra I'll bring the silverware.

The Birth of Romulus, Remus, and Rome

by Dan Stahl

illustration of Romulus and Remus

Rome is known as the Eternal City, but that's an exaggeration. Rome may be old, but it hasn't been around forever. It was founded in or around the 8th century BCE. According to legend, the date of its founding is 21 April 753 BCE.

Rome's age doesn't matter as much as its history. The city began as a village in western Italy. Over the following centuries it grew into an empire that stretched across Europe, North Africa, and the Middle East. A man who lived in Rome as it was growing wrote that its power was second to none except the gods.

That man, whose name was Livy, was a historian. He wrote 142 books about the history of Rome. He believed the city did not develop by chance but by fate.

Livy's books are a mix of fact and legend. What mattered to him was not whether every event he described happened. What mattered was the behavior of the people he wrote about. He urged his readers to study these people and learn from them.

Here is his account of how Rome was founded. You may believe it or not, as you like. What you should do is think about it and learn from it. Oh, and one more thing: enjoy it.

* * *

Before Rome, there was Alba Longa. It was another city in the same part of Italy. The king who ruled it had two sons, Numitor and Amulius. He left his kingdom to Numitor, the older of the two. However, Amulius ousted his brother and took over the kingdom. He then had Numitor's sons executed. As for Numitor's daughter, he made her a priestess. He pretended it was an honor, but it wasn't. It was a ruse to stop her from becoming a mother.

She became a mother anyway. The father of her twin boys was said to be the god Mars, but even he could not protect her and her sons from Amulius. The king had her arrested and ordered that her baby boys be drowned.

Accordingly, the boys were taken to a river. This river, known as the Tiber, had overflowed its banks. The overflow had collected in pools that blocked access to the river. *The pools will do*, thought the king's servants. They left the boys floating in a basket on one of the pools.

Soon the water receded, leaving the twins on land. Nearby was a thirsty she-wolf, which heard the boys crying and veered toward them. She nursed them and gave them a tongue bath. At that point the three of them were discovered by a shepherd. The shepherd was Faustulus, the overseer of the king's flocks. He took the boys home and entrusted their upbringing to his wife.

Once the twins had grown up, they started hunting in the woods. They did not limit themselves to animals. They also attacked robbers, taking their loot and distributing it to neighboring shepherds. The shepherds then teamed up with the twins, forming a posse of youths.

The robbers disliked being robbed and wanted revenge, so they ambushed the posse of young men. One of the twins, Romulus, held his ground. The other twin, Remus, was captured. The robbers hauled Remus to King Amulius, claiming he was a criminal. *He took part in raids on the lands of Numitor*, they said. Accordingly, Remus was turned over to Numitor for punishment.

Concern for Remus led Faustulus to approach Romulus. Faustulus had suspected from day one that the twins were royalty. He knew about the king's order of infanticide, and he knew his discovery of the babies coincided with that order. He now shared this knowledge with Romulus.

Numitor also discerned the truth. While Remus was in his keeping, Numitor heard about the twin's brother. Learning of their age and nobleness, he deduced their identity.

Hence trouble awaited King Amulius on two fronts. First there was Romulus. He was organizing an ambush against the king with the shepherds. Meanwhile, Remus had formed another group at the estate of Numitor. When Romulus's group made its attack, Remus's group came to their assistance. In this way they struck down the king.

Upon the king's death, Numitor called a meeting of the people. In it he disclosed his brother's crimes and his grandsons' identity. At last he revealed the death of Amulius. Romulus and Remus then hailed their grandfather as king. Everyone present approved, and Alba Longa was restored to Numitor.

Now Romulus and Remus were itching to found a city of their own. It would be where they had been

abandoned and brought up. The shepherds and others joined them.

The brothers' plans hit a snag, however. Ambition ran in their family, and now a rivalry developed between them. Because the brothers were twins, neither could claim superiority by age. How, then, to determine the ruler of the new city? Or which of them it should be named after? The gods would have to decide. To receive their answers, Romulus and Remus each went to a separate hill where they awaited a sign from the heavens.

A sign-six vultures-came to Remus first. Just as the sign was proclaimed, twelve vultures came to Romulus. Each brother was hailed by his followers as king. Remus's group justified its claim by the order of the signs, while Romulus's group cited the number of birds. The two groups started debating and wound up brawling. In the turmoil Remus got clobbered and dropped to the ground, dead.

There is another story of Remus's death. In this version, the walls of the brothers' city were under construction. Remus jumped over Romulus's walls to make fun of them. Romulus killed him in a rage, uttering these words: "The same to anyone else who trespasses on my walls!"

In this way Romulus became the sovereign of Rome. The city had been born and was named after its founder.

Note: The story of Romulus and Remus related here is an adaptation. Its source is Book 1 of Ab Urbe Condita *by Titus Livius (Livy).*

Name: _____ Date: _____

1. Whose account of Rome's founding is provided in the text?

A. A Roman king named Faustulus's account

B. A Roman historian named Livy's account

C. An ancient historian named Amulius's account

D. A shepherd named Remus's account

2. Who are the main characters in the story?

A. Amulius and Romulus

B. Numitor and Remus

C. Faustulus and Numitor

D. Romulus and Remus

3. Amulius wanted to prevent Numitor's descendants from reclaiming the kingdom. What evidence from the text supports this conclusion?

A. The father of Romulus and Remus was the god Mars.

B. Amulius tried to stop Numitor's daughter from becoming a mother, then tried to kill her sons.

C. Amulius turned Remus over to Numitor for punishment.

D. Faustulus told Romulus the truth about his birth.

4. How are Romulus and Remus similar to Amulius and Numitor?

A. Both sets of brothers had children that reclaimed their kingdoms.

B. Both sets of brothers decided to establish new cities.

C. Both sets of brothers experienced loss because of uncontrolled ambition.

D. Both sets of brothers fought against the shepherds.

5. What is the main idea of this passage?

A. Much of what we know about Roman history is due to the 142 books written by Livy.

B. Amulius and Numitor ruled a great kingdom that eventually became Rome when Romulus killed his twin Remus.

C. Romulus and Remus both believed they were chosen by the gods to become ruler, leading them and their followers to fight over who should rule the new city.

D. Romulus and Remus retook their grandfather's kingdom and planned to build their own city, but the rivalry that developed between them left Remus dead.

6. Read these sentences from the text.

"Faustulus had suspected from day one that the twins were royalty. . . . Numitor also discerned the truth."

As used in the passage, what does the word "discerned" mean?

A. rejected

B. misunderstood

C. recognized

D. denied

7. Choose the answer that best completes the sentence.

The rivalry between the twins left Remus dead. _____, Romulus became the sovereign of Rome.

A. Otherwise

B. Consequently

C. Initially

D. For example

8. How does Remus die in the first version of the story?

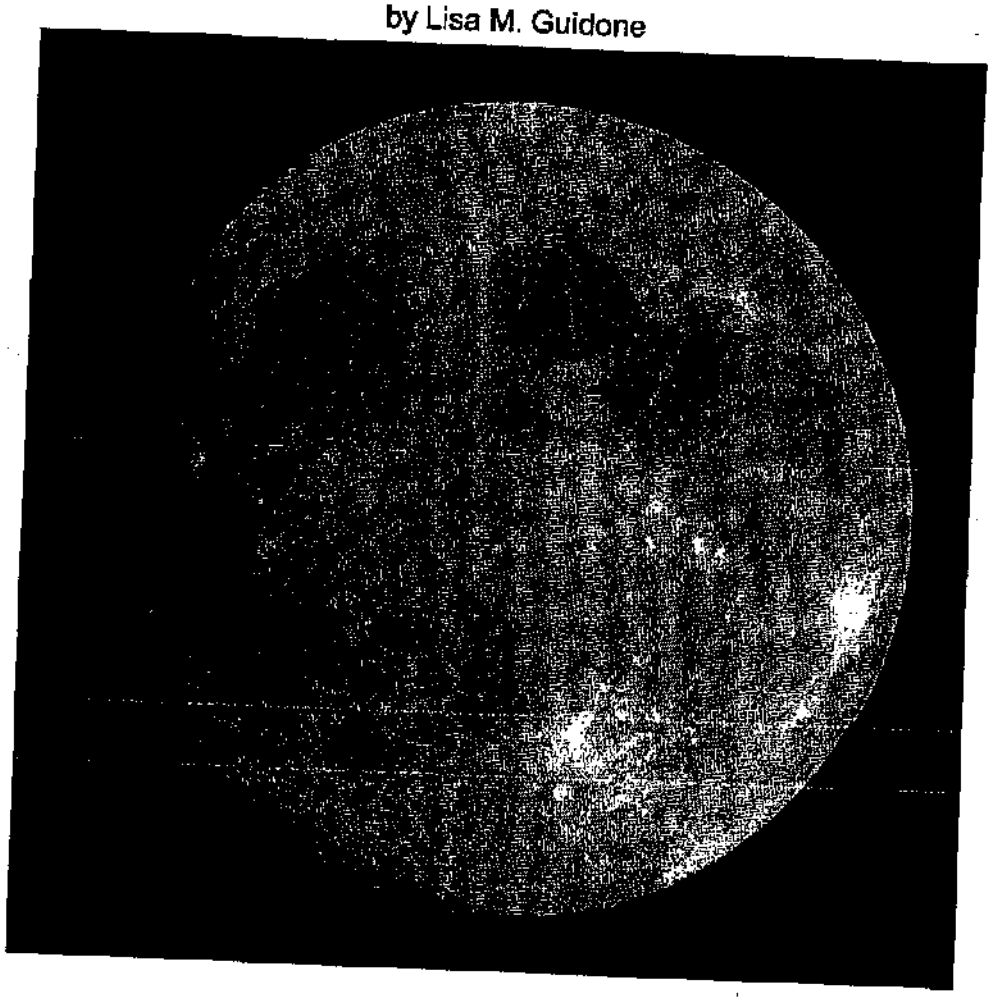
9. How does Remus die in the second version of the story?

10. Livy's purpose in writing the history of Rome was to help readers learn from his characters. What lesson might readers learn from his account of how Rome was founded?

Support your answer with evidence from the text and images.

Living on the Moon

by Lisa M. Guidone



NASA shoots for the moon, then Mars.

Only 12 people have set foot on the moon-so far. The last time was in late 1972, when two astronauts walked on its surface. Their final visit-the longest of any-lasted just three days. Now astronauts are preparing for another **mission** to our space neighbor. This time, though, they plan to stay there.

NASA recently announced plans to build a **permanent** base on the moon. Astronauts could be living and working there by 2020, according to the U.S space agency. The goal is to prepare astronauts for a trip to Mars in the future.

Under the plan, four-person crews will begin with week-long missions to the moon. By 2024, when more equipment has been set up, astronauts will be able to **reside**, or live, on the moon for as long as six months. Astronauts will travel in roving vehicles to explore the area near the **lunar** (moon)

base.

Polar Plus

Unlike Earth, the moon has no air, wind, or weather. Its dusty terrain, or surface, is covered with deep craters. So how can humans survive on the moon?

NASA hopes to establish a lunar outpost near one of the moon's poles. "These locations experience sunlight for longer periods of time than other locations on the moon, which will make it possible to use solar power," NASA official Michael Braukus told *WR News*. Solar power is energy from the sun that can be used to generate electricity.

It is also likely that the polar regions are rich in natural resources, such as oxygen and hydrogen. While on the moon, astronauts plan to use natural resources for water and fuel.

Stepping Up Space Travel

The moon is the only place beyond Earth that humans have visited. About 238,900 miles away, the moon is Earth's closest space neighbor.

On July 20, 1969, Americans Neil Armstrong and Edwin "Buzz" Aldrin became the first humans to walk on the moon. Those space pioneers traveled to the lunar surface on the *Apollo 11* mission.

NASA's new direction is to surpass, or greatly exceed, the Apollo missions of the 1960s and early 1970s. "This is not your father's Apollo," says space policy expert John Logsdon at George Washington University in Washington, D.C.

As part of its new phase of space exploration, NASA retired, or stopped using, its aging space shuttle fleet in 2011. For their trek to the moon, astronauts will travel aboard the new *Orion* crew exploration vehicle, which is being developed. The vehicle, a modernized version of the *Apollo* craft, will attach to a lunar lander.

Next Stop: Mars

The moon mission is part of President George W. Bush's long-term space plan. The proposed base is the first step in the bold plan to prepare astronauts for their ultimate destination-Mars.

Because Mars is so far from Earth, traveling there will require humans to stay for long periods of time. Astronauts will not be able to bring enough supplies for the entire mission. They will have to use the elements on Mars to survive.

"By demonstrating we can survive on another world for a long time, we build confidence that we can venture much farther from Earth and stay for longer periods of time," says Braukus of NASA.

High-Priced Visit

While some supporters are jumping over the moon about launching a new era of space exploration, not everyone is pleased with the plan. Critics warn that it will be difficult to fund the moon program. So far, NASA has not put a price tag on the mission but welcomes participation by other countries to help carry out its plan.

U.S. Space Travel

In October 1957, the Soviet Union launched *Sputnik 1,* the first artificial satellite in space. The U.S. space program was established as a response. The "space race" between the two countries had begun. In 1961, President John F. Kennedy challenged Americans to send a person to the moon by the end of the 1960s.

Name: _____ Date: _____

1. What was the name of the first artificial satellite in space?

A. Sputnik 1

B. Apollo 11

C. Armstrong

D. Orion

2. How does the author describe the moon?

A. as a place very similar to Earth

B. as a place humans have never visited

C. as Earth's closest space neighbor

D. as NASA's ultimate destination

3. Why does the author include the paragraph subtitled "High-Priced Visit" in the article?

A. to explain why some people are criticizing the plan

B. to show how many people support space exploration

C. to describe why the new plan is such a wonderful idea

D. to list all of the places that NASA plans to explore

4. Read this sentence from the passage:

"Solar power is energy from the sun that can be used to generate electricity."

In this sentence, the word **generate** means

A. withhold

B. borrow

C. produce

D. study

5. The primary purpose of this passage is to describe

A. NASA's plan to build a permanent base on the moon

B. the space race between the Soviet Union and the United States

C. American astronauts Neil Armstrong and Edwin "Buzz" Aldrin

D. why NASA decided to retire its aging space shuttle fleet in 2011

6. When did the first humans walk on the moon?

7. What does space policy expert John Logsdon mean by "This is not your father's Apollo" when talking about NASA's new direction?

8. The question below is an incomplete sentence. Choose the word that best completes the sentence.

Astronauts will travel around the moon _____ roving vehicles.

A. or

B. for

C. in

D. and

Name: _____ Date: _____

1. What do you think astronauts will have to do in order to live on the moon?

A. make periodic trips to Earth to get supplies.

B. depend on monthly deliveries of supplies.

C. use the moon's natural resources for water and fuel.

D. bring all their supplies with them.

2. What do you think will be needed for astronauts to live on Mars?

A. Natural resources will be needed on Mars for fuel and energy.

B. The trip to Mars will have to be short.

C. Astronauts will have to leave the Earth in the summer.

D. Only a few astronauts will be able to visit at a time.

3. Neil Armstrong and "Buzz" Aldrin went to the moon, because

A. they wanted to try to use the moon for electricity.

B. Apollo 11 needed four astronauts.

C. the Soviet Sputnik program on the moon needed help.

D. it was one of President Kennedy's goals.

4. In the sentence, "...some supporters are jumping over the moon about launching a new era of space exploration," jumping over the moon means:

A. watching the moon through a telescope.

B. being enthusiastically pleased.

C. planning a new mission to the moon.

D. practicing a new jump rope game.

5. Do you think the United States will be willing to spend the money necessary to send people to live on a lunar base? Explain.

NAME _____ CLASS _____ DATE _____

for CHAPTER 11: CAPITAL LETTERS pages 238–61

Review A: Capital Letters

EXERCISE A Each of the following sentences contains at least one error in capitalization. Circle each letter that should be capitalized but is not. Also, underline each letter that should be lowercased but is not.

Example 1. Tell uncle john about the Show you saw on thursday.

1. Last night i watched a great program on PBS.
2. it was a Play called *Anne of green Gables*.
3. My aunt Dolores, who lives in st. Croix, watched the Program with me.
4. After it was over, she said, "now let's read more about Anne."
5. She and I read L. M. Montgomery's Book *anne of Avonlea*.
6. I read a book about Charles drew, a famous Scientist.
7. He was an african american doctor who was born in Washington, d.c.
8. he was a Specialist in collecting and storing blood for transfusions.
9. During World war II, he helped develop blood banks.
10. The american Red Cross still uses his methods today.

EXERCISE B Each of the following sentences contains errors in capitalization. For each sentence, circle each letter that should be capitalized but is not.

Example 1. My mother likes to eat authentic chinese food at the restaurant China gate.

11. Jonah celebrated his birthday on the fourth thursday of November.
12. The professor studied the french paintings in the louvre.
13. according to mom, uncle pete is visiting spain.
14. The federal bureau of investigation is also known as the fbi.
15. the entire class sang "happy birthday" to dr. Proctor.
16. The cruise ship *voyager express* sailed to florida.
17. a russian scientist won the Nobel prize for his important work.
18. The class watched a video about gen. robert e. lee.
19. While sitting in a booth at salad sam's, Li looked up at the constellation orion.
20. dr. Small's history II class studied the life of president Truman.

MECHANICS

NAME _____ CLASS _____ DATE _____

for CHAPTER 11: CAPITAL LETTERS pages 258–61

Review C: Capital Letters

EXERCISE A Each of the following sentences contains at least one error in capitalization. Circle each letter that should be capitalized but is not. Also, underline each letter that should be lowercased but is not.

Example 1. Is Mr. tyrone kersee, sr., the new Chair of the Committee?

1. Sixth-graders at our School take English, Spanish, math I, and Social Studies.
2. The sahara is an African desert, running from the atlantic ocean to the Red sea.
3. Yogi berra was a Great Catcher who played for the New York yankees.
4. The author joseph conrad was a polish immigrant to great britain.
5. My Elementary School was named after dr. martin luther king, jr.
6. Key West is an Island off the coast of Florida.
7. His Uncle Roberto runs a Gas Station that is across the street from the stokes Building.
8. Does dr. Ranelli see patients at phoenix General Hospital?
9. Muhammad, our class President, practices the religion of islam.
10. south African writer Nadine Gordimer won the nobel prize.

EXERCISE B Each of the numbered items in the following letter contains at least one error in capitalization. For each numbered item, circle each letter that should be capitalized but is not.

Example [1] Marta wrote a letter to aunt Carmelita.

[11] dear Aunt carmelita,

[12] Do you remember that i am in the sixth grade at wilson elementary? [13] My teacher mrs. abel is swiss. [14] In english class, we are reading *The old man and the sea.* [15] In history, we are studying the revolutionary War. [16] I learned a lot about gen. george Washington. [17] In science class, we learned to identify the big Dipper. [18] We are going to learn about the space shuttle *discovery* after the thanksgiving holiday. [19] i will visit you and uncle jaime soon.

[20] sincerely,

Marta

MECHANICS

NAME _____ CLASS _____ DATE _____

for CHAPTER 12: PUNCTUATION pages 262–69

Commas with Items in a Series

12f. Use commas to separate items in a series.

12g. Use commas to separate two or more adjectives that come before a noun.

WORDS IN A SERIES	Our parrot talks, whistles, and sings.
WORD GROUPS IN A SERIES	Every day I uncover the cage, pour the seed, and change the water.
TWO OR MORE ADJECTIVES	Italy is a beautiful, fascinating country.

MECHANICS

EXERCISE A Insert commas where they are needed in the following sentences.

Example 1. Mrs. Sanchez stood up, closed the book, and walked away.

1. Tracy made her bed hung up her clothes and took out the trash.
2. Dale has the following jobs: drying dishes walking the dog and ironing.
3. The plane stops at Chicago Atlanta and Miami.
4. Nick Tom and Molly walk to school together.
5. They hike swim and play volleyball on Friday.
6. Do you live near the school the park or the factory?
7. The flower show had lilies orchids and violets.
8. Mrs. Olson Mr. Ginsburg and Dr. Pratt spoke at the assembly.
9. Oregano adds flavor to sauces soups and pasta.
10. Would you prefer to eat bagels omelets or cereal?

EXERCISE B Some of the following sentences need commas and some do not. If a sentence needs a comma, insert one. If a sentence is already correct, write C next to the number.

Example 1. Did you see the tall, quiet stranger?

11. Old worn tires may be recycled.
12. Yeast in warm moist dough makes bread rise.
13. This is the reddest roundest tomato in the pail.
14. We gathered tiny purple flowers.
15. Some children sang a jolly carefree tune.
16. They played in a cool spacious treehouse.
17. Have you learned the new soccer rules?
18. The fast exciting game was fun to watch.
19. What a colorful soft jacket that is!
20. Mountain goats and antelopes have powerful hind legs.

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Quotation Marks with Direct Quotations

13c–h. Use quotation marks, other punctuation marks, and capital letters correctly to set off direct quotations.

EXAMPLES Janine said, "I like movies with surprise endings."
Patricia asked, "May I help with the decorations?"
"We will begin decorating the gym," said Roger, "at 5:30."
"I found the perfect hamster at the pet store!" cried Yoko.
"The game did not go well," said Dean. "We lost by twenty points."
Who said, "The play starts at 7:30"?

EXERCISE In the following sentences, add quotation marks and other punctuation marks where they are needed. Also, correct any errors in capitalization. If a sentence is already correct, write *C* before the item number.

Example 1. Viviana asked, "May I have milk instead of tea?"

1. Mr. Lasky said, You can leave for the game.
2. Your dress looks like a costume, Mother remarked.
3. Thomas, will you buy the sandwiches? asked Coach Schultz.
4. Jake replied that he didn't mind at all.
5. Judith said, I'll bring paper plates.
6. Who borrowed my ruler Carmen asked.
7. I said that I might have left my book in math class.
8. Grandma cried out a tornado is coming!
9. Who said Each player will receive a prize
10. Renee said that she was joking about the iguana.
11. Can I have an apple, too? asked Fiona.
12. Yikes! shouted Annie. There's a snake on the trail.
13. Casey pulled her lips back over her gums and asked do I have anything on my teeth?
14. Wash the dishes, instructed Dad, and afterward we'll play chess.
15. Beauregard is the name of my new pet rabbit announced the girl proudly.
16. Sometimes, said Felipe, I go to the Tejano record store in my electric wheelchair.
17. Catch Fido before she catches that cat! screamed Greg.
18. Who said, I have your sweater?
19. I told him that I didn't want to be on the team.
20. I have learned the names of the constellations, said Ashley, but can't identify them yet.

How To Trick Your Sister

by ReadWorks

The plan was perfect. Rick had been working on it all week: in Math class, English class, and History class. He sat in the back of the room, deep in thought. To the teacher, it looked like he was taking notes. In fact, he *was* taking notes-but not on Algebra, *To Kill a Mockingbird,* or the Spanish-American War. Rick was a schemer, and now he had dreamed up the greatest scheme of his career.

He was going to ruin his sister's birthday party.

Rick didn't have anything against Emily. She was a nice enough sister. She helped him do the dishes, she kept out of his room, and on long car trips, she let him sleep when he wanted to sleep. But Rick loved playing tricks, and when it came to tricks, there was no better target than Emily.

She liked her life to be orderly. She liked everything in its place. When she was taking notes in school, she used nine different pens-all different colors-in an organizational scheme so complex, it would take FBI scientists weeks to decode it.

Rick was not like that at all. He was a messy kid. He liked his bedroom to be covered in dirty clothes and crumpled-up paper. He liked his music loud and his fireworks louder. And surprises were his favorite thing in the world.

The notebook he used in the back of math class didn't say "MATH" on it. It said, "Surprises-Top Secret! Do Not Open!" In it were the records of every trick he had ever played. There was the time he made his sister think all her dolls had moved away. There was the time he'd hidden Dad's car keys and made him two hours late for work. And there was his last great accomplishment-the time he disconnected the oven, and made Mom think that Thanksgiving dinner would never be finished.

That last trick would be hard for most kids, but Rick, though he never did great in school, was smart with his hands. His father was a mechanic, and had shown him all sorts of neat things he could do with machines. Rick could fix washing machines, dishwashers, showers and garage door openers. He could also, when it suited him, disconnect them completely.

"I am a mechanical wizard," he wrote in his notebook. "No! A genius. Better yet-an evil genius."

This was going to be his greatest triumph. All he needed was a remote control, a few bits of radio equipment and two dozen small fireworks. If there were a Nobel Prize for evil, he thought he would win it, for sure.

The night before her party, Emily couldn't sleep. It was always like that when she was excited. She kept playing the party over in her mind. All the girls from her class were coming and everyone was going to have a wonderful time. With her mother's help, Emily had planned everything down to the last detail. She had filled a binder with plans for games they would play, stories she would tell and outfits she might wear. She had settled on a pale green dress with matching sandals. It was a simple outfit, but that was perfect. She didn't want anyone to know how much she was looking forward to this.

The girls at school were nice to Emily, but there were none who would call her their friend. She was a shy person. In class, she always knew the answer, but never raised her hand. When she was with the other girls, she was like that too. Even when she knew the right thing to say, her mouth would freeze. She couldn't say it. At night she would torture herself with the knowledge that she was funny, charming and smart. She just didn't know how to make that side of her come out.

Perhaps it would happen at her party. Perhaps she would emerge from her shell like a very organized butterfly. Perhaps at school the next week, she would have friends.

If the party didn't work, it certainly wouldn't be her fault. This would be the finest birthday party of the season. The napkins would be colorful. The games would be fresh and exciting. And the cupcakes would be out of this world.

"Are you sure you want cupcakes?" her mother had asked. "Maybe I'm old-fashioned, but I don't see what's wrong with a nice ordinary caramel cake. I'll make you one myself!"

"I know you will, Mom," said Emily. "You've made one for me every year since I was born. Caramel cakes are delicious, but they're boring. Cupcakes are popular. Cupcakes are fun."

Her mom agreed. They would have cupcakes: two dozen of them in every color of the frosting rainbow. To keep Rick away from them, her mother had placed them under lock-and-key. She had

arranged for his friend Andy to come over during the party. They would be in the basement playing video games the entire afternoon. Emily didn't think it was possible for Rick to ruin her party if he wasn't allowed out of the basement.

She hadn't counted on a remote control.

Rick was proud of his handiwork. Each firework was attached to a tiny remote detonator, the size of a pea. He stashed them in the back of the pantry, the morning of the party, before his mother made him go into the basement to hang out with Andy.

"You two just stay down here until all the girls have gone home," his mom said. "I don't want you doing anything that might upset your sister."

"I promise I won't come through that door until the party is over," said Rick. His mom didn't understand why he was smiling.

In the basement, Mom had laid out a platter of sandwiches, soda, and cookies for Rick and Andy, but Rick was too excited to eat. From upstairs, he heard the telltale signs of a girl's birthday party: screaming, squealing and laughter loud enough to shatter a window.

"It sounds like they're having a lot of fun up there," said Andy, who wished he could be part of the party.

"Not for long," said Rick. "Hand me that step ladder."

He had promised his mother he wouldn't come through the door, and he was going to keep that promise. There was a small window on the far side of the basement, just big enough for him to crawl through. With Andy holding the ladder, Rick unlatched the window, squirmed through the frame, and crawled into the backyard.

"Wait here," said Rick. "Don't close the window. I'll be back in five minutes."

"Can I play FIFA?" asked Andy.

"You can play whatever you want! Just don't close this window."

He army-crawled around the house to the door that led into the kitchen. Through the window, he saw his mother arranging the cupcakes on a tray. It was nearly time to strike.

In Rick's family, the tradition was to sing "Happy Birthday" while the cake was still in the kitchen. Only when the song was over would mom bring out the cupcakes, candles lit, and frosting shimmering. This was Rick's opportunity.

Mom went into the dining room and the singing started. Moving quickly but silently, Rick opened the kitchen door and went to work, nestling a tiny firework in the bottom of each cupcake. He resisted the urge to eat one of the little cakes. This was no time to goof around. By the time the song had finished, the cakes appeared undisturbed, and Rick had disappeared.

"All right girls," said Mom. "Here we go! Cupcakes, just like I promised."

"I want the green one!" said Rachel McKeown.

"I want the red one!" said Angela Beck.

"I want the pink one and the yellow one and the blue one and the rainbow one!" said Mary Kucan, who really loved cupcakes.

"Hold on, hold on, hold on," said Mom. "There's plenty for everybody. The one with the rainbow is for Emily."

"Thanks Mom," said Emily, as she placed the cupcake on the plate.

"These look awesome," said Angela.

"Totally," said Rachel.

"I want to eat them all," said Mary. "Can I eat all of them?"

"This is perfect, Mom," said Emily. "Thanks so much."

And it was perfect. Everyone from school was here, and they were all having a great time. Emily had been funny; she had been fun. "This is the best party any of my friends have ever thrown," Rachel had told her. No one at school had ever called her "friend" before. The party had gone wonderfully, and Rick couldn't spoil it now.

"All right, girls," said Mom. "Dig in."

And that was when the explosions started. Two dozen little pops-like hail falling on a tin roof-went off, one after the other. When the girls' ears stopped ringing, there was smoke in the air and icing covering every surface: pink icing on the table, green icing on the ceiling and rainbow icing all over Emily's green dress. After a moment, the silence was broken. Emily started to cry.

As the tears began to slip from her eyes, she felt a firm grip on her elbow. "Don't," said Rachel. "Do not cry. We're going to get him. Say it with me. We are going to get him."

"We are?" said Emily.

"He's pretty handy, isn't he? Are you good with machines too?"

"I guess so. My dad taught us all sorts of things."

"Then we'll need a little motor and a lot of fishing line."

"What are we going to do with it?"

"Tell me," said Rachel, with a mischievous grin spreading across her face. "What is your brother's favorite thing in the world?"

It was an hour before Mom let Rick out of the basement. She was furious. But she was so confused and upset, that she didn't even know how to punish him yet.

"Go to your room," she said from the top of the basement stairs.

"Why?" he asked. "What happened? I was down here the whole time. Wasn't I, Andy?"

Andy didn't say anything. He was too smart to get involved in family fights. He slipped out behind Rick's mother, and went to wait for his father to pick him up. Mom stood there, jaw clenched and face red.

"Just go to your room," she said. "Go!"

Rick whistled quietly as he walked to his bedroom, pausing in the dining room to inspect the scene of the carnage. In his head, he began imagining the way he would write this down in his journal of nasty tricks. Never before, he thought, has a birthday party been so thoroughly ruined. This one will go down in history. At the table, Emily and one of the other girls from school-Rachel, maybe?-sat quietly. They said nothing to him as he passed them by, whistling just a teeny bit louder.

He opened his bedroom door and found everything just the way he liked it. Clothes were piled on the floor, dirty cups and bowls were on all the windowsills, and his journal was just where it was supposed to be-hidden behind the bookshelf by the door. As he reached for it, he heard a whirring noise, and the journal jumped away from his hand.

"What the heck?" he said. He grabbed for the journal but it jumped away again, slipping across the floor like a gecko. Someone had tied a string to it, and the string was connected to some unseen machine. He chased the journal across the room, into the hallway and down the stairs. It gained speed as it was dragged into the dining room. He took the corner too fast, slipped on a piece of cake and watched helplessly as his life's work was dragged through gobs of icing.

"Stop it!" he said. "It's getting icing all over! Emily-stop it!"

Emily said nothing, but Rachel allowed herself a tiny smile. By the time Rick was on his feet again, the journal had been dragged into the hallway. He chased it all around the first floor-from the kitchen to the living room and back one last time into the dining room, where he slipped a second time. He followed the book into the den but didn't see where it had gone. Finally, he heard a crackling sound, and saw his journal burning in the fireplace. It was already too late to save.

Rick burst into the dining room, face red with icing and rage.

"You!" he said. "You destroyed my journal. You, you, you! You played a terrible trick on me!"

"I don't know what you're talking about," said Emily, as she licked a bit of icing off her finger. "You can ask my friend, Rachel. We were here the entire time."

Name: _____ **Date:** _____

1. What trick does Rick play on his sister?

A. He hides her car keys and makes her two hours late for work.

B. He disconnects the oven and makes her think that Thanksgiving dinner will never be finished.

C. He sets off fireworks inside the cupcakes at her birthday party.

D. He attaches a string to her notebook and uses a motor to pull it into the fireplace.

2. What is the resolution at the end of the story?

A. Tears begin to slip from Emily's eyes because the cupcake icing has gotten everywhere.

B. Emily keeps playing the party over in her mind instead of going to sleep.

C. Emily feels a firm grip on her elbow and tells Rachel that she is good with machines.

D. Emily takes revenge on her brother by pulling his journal into the fireplace with a string and motor.

3. Emily is excited for her birthday party.

What evidence from the passage supports this statement?

A. Emily cannot fall asleep the night before the party.

B. Emily helps her brother do the dishes and lets him sleep on long car trips.

C. Emily uses nine different pens to take notes in school.

D. Angela Beck wants to eat the red cupcake.

4. Why does Rick decide to ruin his sister's birthday party?

A. He is a messy kid who likes his bedroom to be covered in dirty clothes.

B. His sister's birthday party is a great opportunity for playing a trick.

C. He can fix washing machines, dishwashers, showers, and garage door openers.

D. He army-crawls around the house to the door that leads to the kitchen.

5. What is this story mostly about?

A. a girl who wants to eat all the cupcakes at someone else's birthday party

B. a trick that a boy plays on his sister and the trick she plays in return

C. a mother who gets mad when her son plays a trick on her daughter

D. a journal that a boy uses to keep a record of the tricks he plays on people

6. Read the following sentences: "He sat in the back of the room, **deep in thought**. To the teacher, it looked like he was taking notes."

What does the phrase **deep in thought** mean?

A. It means that someone is sitting in a short chair very close to the floor.

B. It means that someone is sitting in a tall chair very far from the floor.

C. It means that someone is thinking a lot about something.

D. It means that someone is not thinking very much about something.

7. Choose the answer that best completes the sentence below.

Rick tricks Emily; _____ Emily tricks Rick.

A. in contrast

B. for instance

C. first

D. then

8. What trick does Emily play on Rick?

_____

_____

_____

9. Why does Emily play a trick on Rick? Support your answer with evidence from the story.

10. How does Emily feel at the end of the story? Explain your answer with evidence from the passage.

Endangered Animals at a Glance

Back to the Wild

Not all the news is bad about endangered animals. In the United States, dozens of endangered animals have been making a comeback. Here are few of them:

Gray Wolf: By the 1970s, the gray wolf had all but vanished from Yellowstone National Park. In 1995 and 1996, federal biologists brought 66 wolves from Canada and set them free in the wilderness areas of the park and central Idaho. Today, about 285 gray wolves live in central Idaho, and 271 more roam Yellowstone.

Bald Eagle: Before Europeans came to North America, the sky was teeming with bald eagles. As settlers moved west, they destroyed the eagles' natural habitat. Egg collectors and pesticides almost wiped out the bald eagle population.

However, about 30 years ago the federal government passed laws to protect the eagles. Today, more than 7,678 pairs of bald eagles live in the lower United States.

U.S. Fish and Wildlife Service

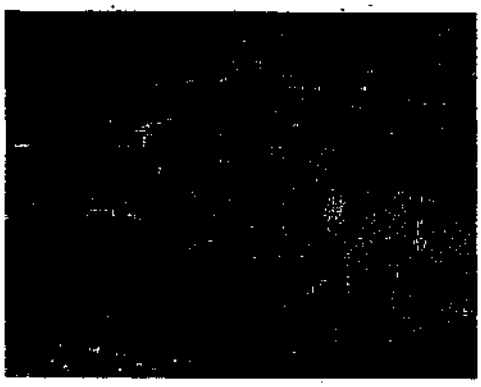
Grizzly Bear

Grizzly Bear: In the 1800s, an estimated 50,000 grizzly bears roamed the West. Today, the bears are making a comeback in several Western areas, including Yellowstone Park.

Can Zoos Help Save Endangered Animals?

Emi is a crowd-pleasing Sumatran rhinoceros at the Cincinnati Zoo. Why is she so popular? In 2004, Emi gave birth to Suci, a healthy, wide-eyed female calf.

Although most visitors to the zoo enjoy gazing at Emi and Suci, scientists are happy for another reason. Suci's arrival brings scientists a step closer to pulling the Sumatran rhinoceros back from the edge of extinction.



sxc.hu

Sumatran rhinoceros

As the populations of wild animals dwindle, conservationists are hoping that they can breed animals in zoos and later release them into the wild.

Scientists have reintroduced at least 19 species to the wild from captivity. For example, by 1985 only nine wild California condors were living in that state. Biologists captured all nine and began a captive breeding program. As of July 2005, the number of condors increased to 280, with more than 120 living in the wild.

Name: _____ Date: _____

1. The passage explains why some endangered animals, including gray wolves and bald eagles may

A. be getting killed at increasing rates

B. be making a comeback

C. be hard to find

D. be living in zoos

2. The big problem described in the passage is that many animals at one time were in danger of extinction. The passage also describes the efforts that contributed to solving this problem which include

A. arresting hunters and importing animals from other countries

B. federal laws and breeding animals in captivity

C. breeding animals in captivity and allowing animals to roam freely

D. importing animals from other countries and feeding them special food

3. Which of the following conclusions are supported by the passage?

A. Scientists do not want to breed animals in zoos.

B. Endangered animals may no longer survive.

C. Zoos should not help endangered animals.

D. People have been able to find ways to save endangered animals.

4. Read the following sentence:

"As the populations of wild animals dwindle, conservationists are hoping that they can breed animals in zoos and later release them into the wild."

In this sentence the word **dwindle** means

A. sickly

B. missing

C. decline

D. raise

5. Which statement best describes the main idea of this passage?

A. People are harming endangered animals.

B. Endangered animals need our help.

C. Scientists are trying to find a way to help animals to find safe places to live.

D. Some endangered animals are increasing in number.

6. When the gray wolf had nearly vanished, what did people do to help prevent it from becoming extinct?

7. Why might conservationists want to breed animals in captivity?

8. The question below includes an incomplete sentence. Choose the word that best completes the sentence.

At one time only nine wild California condors were living in that state. _____ May 2012, that number has increased to 405 with about 226 living in the wild.

A. Next

B. Now

C. Since

D. When

Name: _____ Date: _____

1. Scientists are happy about Suci's birth because the Sumatran rhino was almost extinct. The public is happy mostly because

A. she has a sibling.

B. she attracts the condors.

C. she stays in the water.

D. she is fun to look at.

2. "Dwindle" apparently means

A. grow.

B. teem.

C. decrease.

D. capture.

3. The gray wolf has avoided extinction because

A. people stopped hunting gray wolves.

B. Canadian wolves set free in Idaho reproduced.

C. all their predators became extinct.

D. farmers stopped using pesticides.

4. Yellowstone Park is seeing a comeback of which two kinds of endangered species?

A. rhinoceroses and condors.

B. grizzly bears and gray wolves.

C. California condors and gray wolves.

D. bald eagles and grizzly bears.

5. Why might animals reproduce better in a captive breeding program than in the wild?

_____

_____

_____

Name: _____ Date: _____

1. The _____ was almost extinct in the 1970s.

A. gray wolf

B. bald eagle

C. grizzly bear

D. all of the above.

2. The _____ decreased in numbers because their young did not have a chance to be born.

A. California condors

B. rhinoceros

C. bald eagle

D. grey wolf

3. Which of the following is not an opinion?

A. It is important to keep the California condor alive.

B. The grey wolf is too dangerous.

C. There are more Grizzly bears now than there were in the 1970s.

D. The U.S. should pass more laws to keep other animals from extinction.

4. _____ were bred in captivity and let back into the wild.

A. Grizzly Bears

B. California Condors

C. Rhinoceroses

D. Bald eagles

5. What are some possible problems when zoos breed wild animals and put them back into nature?

Name: _____

Date: _____ Per: _____

Article Summary

Write a summary for any article in the magazine.
Start by reading the entire article. Then re-read the article and take 8 notes.

- _____
- _____
- _____
- _____
- _____
- _____
- _____
- _____

Now write the summary, **starting with an I-V-F topic sentence** and transforming your notes into complete, interesting, and varied sentences with transitions.

The article "_____" describes

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

The First Emperor of China

Was the Emperor of Qin an effective leader?

PREVIEW

Place an *X* in the column that indicates whether you think each of the actions described below is evidence that a leader is effective or ineffective.

Leader	Effective	Ineffective
A leader who has absolute control over his people		
A leader who unifies the government		
A leader who makes laws for everyone to follow		
A leader who protects his people from invaders		
A leader who has his opponents killed		
A leader whose legacy lasts years beyond his death		

Which *one* of the actions makes a leader the *most effective*? Which *one* of the actions makes a leader the *least effective*? Explain your choices.

READING NOTES

Social Studies Vocabulary

As you complete the Reading Notes, use these terms in your answers.

Qin Shi Huangdi	Great Wall	immortal
standardize	censor	

Section 1

Step 1: In the image at right, circle and label three interesting details. Then, in the space below, explain what you think these details reveal about the Emperor of Qin. You may also look at this image in Section 1 of the Student Text.

Step 2: Read Section 1. Answer the questions below in complete sentences.

1. Did Qin Shi Huangdi's control of China help or hurt the country? Explain.

2. How did Qin Shi Huangdi end feudalism? Why did he do this?

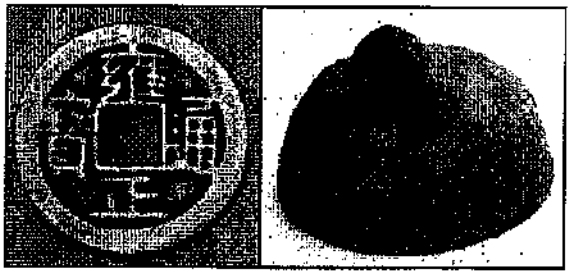
Step 3: Did the Emperor of Qin's efforts to control China make him an effective ruler? Mark your answer with an *X* on the spectrum below.

Very Ineffective

Very Effective

Section 2

Step 1: In the images at right, circle and label three interesting details. Then, in the space below, explain what you think these details reveal about the Emperor of Qin. You may also look at these images in Section 2 of the Student Text.



Step 2: Read Section 2. Answer the questions below in complete sentences.

1. Why did the Emperor of Qin create a unified set of laws? How did his Legalist beliefs affect these laws?

2. How did Qin Shi Huangdi improve trade and writing in China?

Step 3: Did the Emperor of Qin's efforts to standardize Chinese culture make him an effective ruler? Mark your answer with an *X* on the spectrum below.

Very Ineffective

Very Effective

Section 3

Step 1: In the image at right, circle and label three interesting details. Then, in the space below, explain what you think these details reveal about the Emperor of Qin. You may also look at this image in Section 3 of the Student Text.

Step 2: Read Section 3. Answer the questions below in complete sentences.

1. How did the emperor protect China's northern border?

2. Who constructed the Great Wall? What difficulties did they face?

Step 3: Did the Emperor of Qin's efforts to protect China's northern border make him an effective ruler? Mark your answer with an *X* on the spectrum below.

Very Ineffective

Very Effective

Section 4

Step 1: In the image at right, circle and label three interesting details. Then, in the space below, explain what you think these details reveal about the Emperor of Qin. You may also look at this image in Section 4 of the Student Text.

Step 2: Read Section 4. Answer the questions below in complete sentences.

1. Why was there a conflict between Confucian scholars and the emperor?

2. What did the emperor do to prevent people from learning about Confucianism?

Step 3: Did the Emperor of Qin's efforts to end opposition make him an effective ruler? Mark your answer with an *X* on the spectrum below.

Very Ineffective

Very Effective

Section 5

1. Explain whether you think the Emperor of Qin achieved each of these goals:
   Goal 1: To become immortal

   Goal 2: To be remembered for a long time

2. List three things that were buried in the Emperor of Qin's tomb. What do these items reveal about the emperor?

PROCESSING

On a separate piece of paper, complete one of the two activities described here, depending on your answer to this question: *Do you think Qin Shi Huangdi was an effective or an ineffective ruler?* If you believe he was effective, design a commemorative plaque. If you believe he was ineffective, design a "wanted" poster. Your plaque or poster must contain the following:

- a title that indicates whether it is a commemorative plaque or a "wanted" poster
- a picture of the emperor
- at least three actions of the emperor that justify this plaque or poster, with illustrations for each action

READING FURTHER

Preparing to Write: Considering Great Monuments

Many people who travel to China feel that they must visit the Great Wall. Why do you think this is so?

What natural or human-made monument in your state or community is visited by tourists? What is special about it?

What are some similarities between your state's monument and China's Great Wall? What are some differences between them?

Monuments often attract commercial and recreational activities. What kinds of activities do you think should be allowed at such monuments? What activities do you think should not be allowed? Explain your reasoning.

Examples: Selling souvenirs; holding parties at the site; taking materials from the site for personal use or for use in home or road building

Writing a Diary Entry

Suppose that you are visiting the Great Wall of China. Write a diary entry about your visit. Describe in detail what you see there. Include facts about the wall, information the local people might tell you, and your own impressions. Use details from the article you have just read, and from the accompanying photographs, to help you write your entry. Add sketches or other visuals to add interest to your diary entry.

Use this rubric to evaluate your diary entry. Make changes to your work if you need to.

Score	Description
3	Each point is very relevant to the topic and is supported by the text and visuals. There are no spelling or grammar errors.
2	The points are somewhat relevant to the topic. Some statements may not be supported by the article or the visuals. There are some spelling or grammar errors.
1	Few or none of the points are relevant to the topic. Statements have little or no connection to the facts as given in the article or shown in the visuals. There are many spelling or grammar errors.

The First Emperor of China

Was the Emperor of Qin an effective leader?

Introduction

In the later years of the Zhou dynasty, China entered a period of unrest that lasted until the Qin dynasty seized power. During this dynasty, China became unified under Qin Shi Huangdi (chin SHEE hwahng-dee).

The Emperor of Qin (chin) ruled over a united China from 221 to 210 B.C.E. His reign was one of great contrasts. He executed hundreds of enemies, and his building projects killed thousands of his own people. However, he also unified Chinese government and culture.

The emperor's construction **projects** were among the most spectacular in the world, the largest of which was the Great Wall along China's northern border. The wall was intended to protect China from invasion from the north. Much like a general would prepare for a war, the Emperor of Qin made plans to build his wall. Supply camps were set up to bring food and materials to the workers in the mountains and deserts of the northern **frontier**. Soldiers were posted to fight off bandits and to prevent workers from running away. Thousands of Chinese were marched from their homes and forced to work on the wall. It is said that many of them never returned.

Clearly, the Emperor of Qin was both a strong leader and a cruel one. It is little wonder that later historians would have very differing opinions of this ruler and his impact on China. In this lesson, you will read about the Emperor of Qin and develop your own opinion.

THE FIRST EMPEROR OF...

Social Studies Vocabulary

censor

Great Wall

immortal

Qin Shi Huangdi

standardize

1. Creating an Empire

China's first emperor began life as Prince Zheng (jung) of the royal family of the state of Qin. He was born in 259 B.C.E., near the end of the Warring States period. In 256 B.C.E., Qin rulers took over the state of Zhou, ending the Zhou dynasty. Ten years later, 13-year-old Prince Zheng became king.

Occasionally called the Tiger of Qin, Zheng was quite an ambitious man. He used military might, spies, bribery, and alliances to conquer the remaining rival states. His kingdom ultimately became far larger than those of earlier dynasties. In 221 B.C.E., he gained control of all of China and decided to take a new title, **Qin Shi Huangdi**, or First Emperor of Qin.

As a ruler, the Emperor of Qin was greatly influenced by Legalism. Legalists believed in strict laws, harsh punishments, and a strong central authority. The emperor adopted these ideas. To avoid threats from powerful lords, he replaced the old system of feudalism with a government he controlled personally. He divided his vast territory into 36 districts. Three officials were appointed to govern each district. One official was responsible for the army. Another held authority over the laws and agriculture. The duty of the third official was to keep the emperor informed of district activities.

The Emperor of Qin used harsh measures to maintain his power. When he discovered plots against his life, he ordered the traitors and their families to be executed. He even exiled his own mother from court, fearful that she was plotting against him.

2. Standardizing the Culture

The Emperor of Qin aimed to unify China. He began to **standardize** cultural practices that differed from location to location.

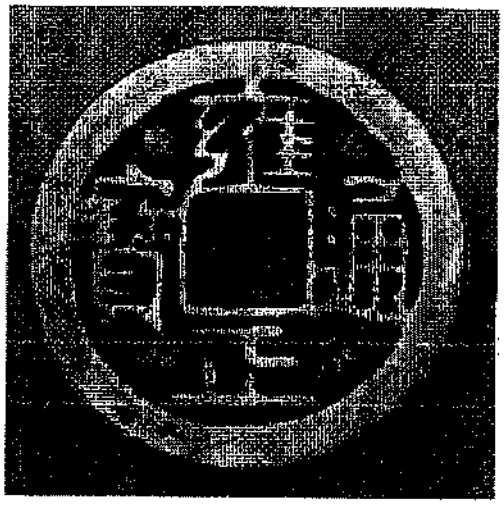
One key step was to develop a uniform system of laws, a number of which were aimed at government officials. Officials were punished if the grain in storehouses spoiled, or if a wall constructed under their supervision collapsed. Other laws governed everyday life. For example, widows were forbidden to remarry.

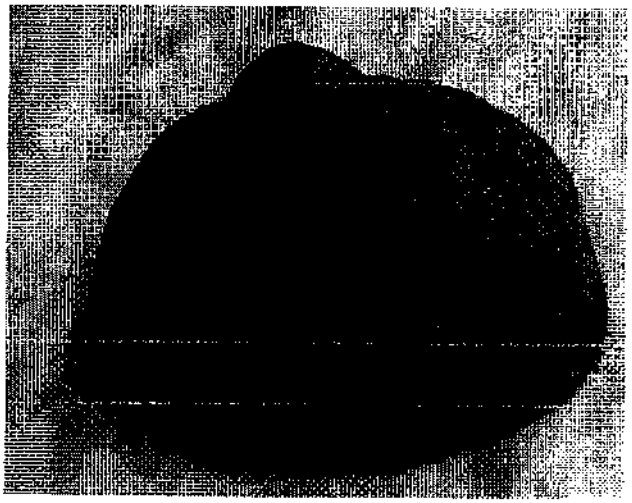
Based on Legalist beliefs, the emperor's laws were detailed and spelled out exact punishments for people who broke them. Rich and poor were punished in the same way. Typical punishments included fines that were paid in shields, gold, or suits of armor. However, there were also physical punishments that included forced labor, whippings, and beheadings.

To make trading easier, the emperor standardized money, weights, and measures. Throughout China, people had used various types of items

as money, such as shells, pearls, silver, tin objects, and coins. The Emperor of Qin commanded that metal coins of gold or bronze would be the only acceptable form of currency. A hole in the center of each coin enabled people to carry several coins together on a cord. The emperor also ordered that measuring cups be designed to hold consistent amounts. To regulate weights, he had metalworkers create bell-shaped bronze or iron weights in a variety of standard sizes.

Shi Huangdi also simplified the writing system. He removed many of the written characters that were in use across China. A later dictionary listed 9,000 approved characters.





3. Protecting the Northern Border

To protect his empire from invaders, the Emperor of Qin forced workers to build an **enormous** wall along China's northern border. Earlier kingdoms had previously constructed smaller walls of their own. The emperor ordered long sections built to connect these walls and extend the wall to the west. The complete structure was called the "10,000 Li Long Wall." (One *li* is about three-tenths of a mile.) It later became known as the **Great Wall**.

Few traces of the original Great Wall survive. The Great Wall as it is known today was built by later rulers. Most likely, the original wall was made up of layers of earth pounded into wooden frames that held all the components together.

The Emperor of Qin's wall took ten years to complete. A workforce of 300,000 men was assembled to construct it. Some were soldiers, while many were peasants who were forced to renounce farming to work on the project. Still others were musicians, teachers, writers, and artists

that the emperor had previously exiled to the north.

The men who built the wall worked under difficult conditions since the wall crossed high mountains, deserts, swampland, and quicksand. The weather was bitterly cold in the winter and blazingly hot in the summer. According to later accounts, tens of thousands of men died while working on the project, and their bodies were buried in the wall.

Combined with strong Chinese armies, the Great Wall proved extremely effective at stopping invasions. Nomads living to the north of the wall were unable to move sheep or cattle over it, and horses could not jump it. Therefore, any invaders who managed to scale the wall would be left without supplies or horses.

4. Ending Opposition

The changes that the Emperor of Qin introduced to unify and protect China drew a great deal of opposition. They were especially unpopular with Confucian scholars, who believed in behaving properly and setting a good example rather than enforcing harsh laws.

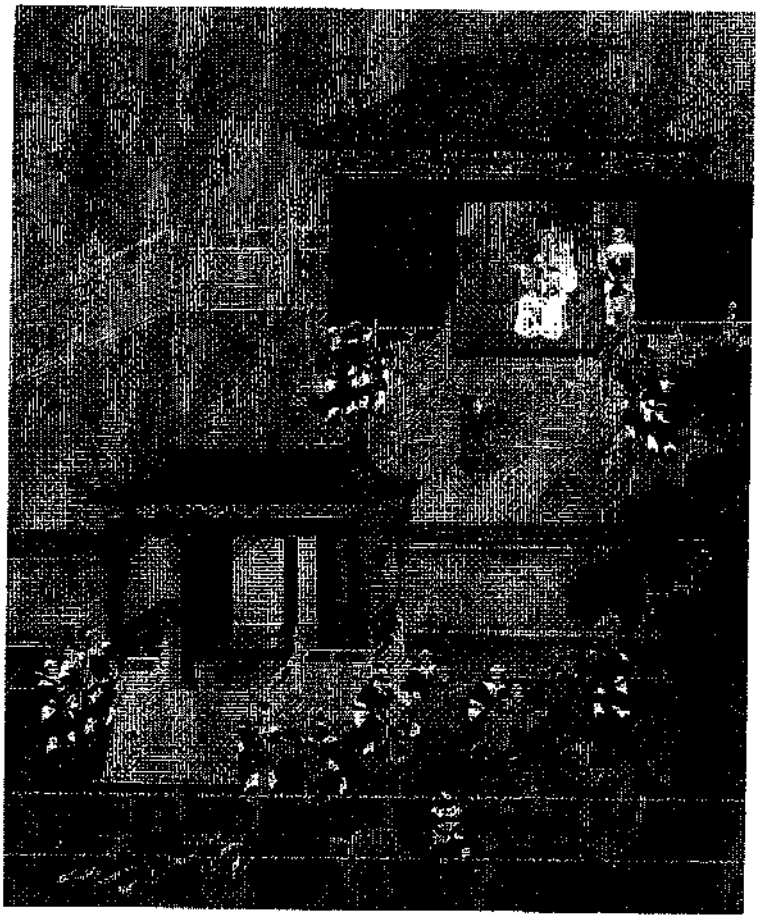
The emperor was determined to end any opposition to his rule. It is said that he executed 460 Confucian scholars for plotting against him.

The conflict between the emperor and the scholars worsened during a royal banquet in 213 B.C.E. During the meal, one Confucian scholar criticized the emperor, warning that the Qin dynasty would not endure unless the emperor followed the ways of the past.

The scholar's comments angered the emperor's trusted adviser, Li Siu (lee sway), who informed the emperor that scholars' criticisms were causing trouble, and the government should **censor** the scholars. No one, he declared, should be allowed to learn about Confucianism. All Confucian literature must be brought to the capital city and burned. Only books discussing medicine, farming, and the history of the Qin kingdom should escape censorship.

The Emperor of Qin agreed to order the book burning. He said that scholars who disobeyed the order would be marked with a tattoo on their faces and sent to do forced labor. In addition, anyone who discussed ancient teachings would be guilty of criticizing the government and would be executed.

The emperor's brutal action shocked the people of China. Some scholars chose to die rather than surrender their books. Even the emperor's son became a victim of his father's campaign to end opposition. When the son objected to the killing of scholars, he was sent to oversee work on the Great Wall.



5. The Emperor's Death and the End of the Qin Dynasty

Despite the Emperor of Qin's many achievements, some ancient Chinese writings say that he could not find happiness. Above all, the emperor was afraid to die, so he summoned magicians to his court and asked how he could become **immortal**, or live forever. Some magicians informed him that he should seek a magic potion. The emperor searched far and wide for such a potion. He once sent an expedition all the way to islands in the sea that is east of China.

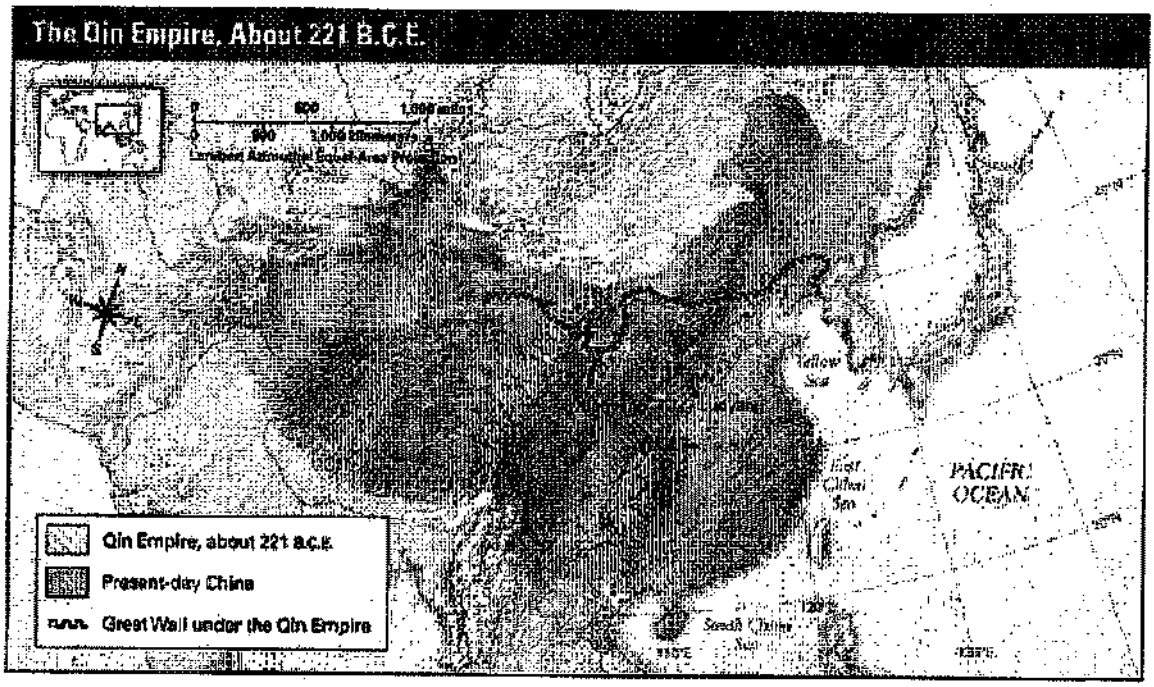
The Death and Burial of the Emperor of Qin In 210 B.C.E., the Emperor of Qin died after ruling for just over ten years. He had been off searching for the magic potion, 600 miles from the capital city. No one knows the exact cause of his death, but some suggest he was poisoned.

The Emperor of Qin's body was transported back to the capital and buried in a huge tomb in a human-made mound. The tomb complex, or group of structures, covered many square miles. Ancient Chinese writings state that more than 700,000 workers helped construct it. Some of them were buried with the emperor to prevent grave robbers

from learning about the tomb's fabulous treasures.

The treasures in the Emperor of Qin's tomb were not uncovered until 1974 C.E. Among them were tools, precious jewels, and rare objects. However, the most amazing discovery of all was an entire army made of a kind of clay called terra-cotta. The army included more than six thousand life-size figures such as archers, foot soldiers, chariot drivers, and horses. So far, archaeologists have yet to find any two figures that are exactly alike.

The End of the Qin Dynasty Shi Huangdi died in 210 B.C.E. The harshness of the emperor's rule had caused much unhappiness across China. After his death, rebellions broke out in the countryside. Members of royal families from conquered states joined in the **revolt**. As various leaders competed for power, civil war raged. Finally, in 206 B.C.E., Liu Bang (LEE-oo bahng), a peasant leader, gained power and established the Han dynasty.



Lesson Summary

In this lesson, you learned about Qin Shi Huangdi, China's first emperor.

Creating an Empire Qin Shi Huangdi was influenced by Legalism. He replaced feudalism with a strong central government under his control. He divided his territory into 36 districts, each governed by three officials. He used harsh measures to enforce his power.

Standardizing the Culture The Emperor of Qin unified China and also greatly expanded its borders. He standardized Chinese laws, money, weights, measures, and writing.

Protecting the Northern Border Among the emperor's many construction projects was the Great Wall, which he built to protect China's northern border from invaders.

Ending Opposition Many of Emperor Qin's actions aroused opposition. He brutally censored and executed his critics, including Confucian scholars.

The Emperor's Death and the End of the Qin Dynasty Although the emperor searched for a way to become immortal, he died in 210 B.C.E. He was buried in a huge tomb, along with many treasures and an army of 6,000 life-size terra-cotta figures. His amazing tomb was

discovered in 1974. Revolt broke out after his death, and civil war raged until the Han dynasty was established.

Reading Further

China's Great Walls

Is the Great Wall of China visible from space? Some people claim it is, while astronauts who have viewed Earth from space argue that it is not. And who gets credit for building this enormous wall? The emperor Qin Shi Huangdi began building the wall more than 2,200 years ago, but the Ming emperors expanded upon it about 500 years ago.With the wall's complex history, how can we separate fact from fiction?

There is a lot of contradictory information about China's Great Wall, in part because it is not *one* wall, but many. The wall once ran the length of all of northern China, from the Pacific Ocean to the western desert. However, there were also a lot of branches and extensions.

The Chinese themselves did not refer to the structure as the "Great Wall of China" until about one hundred years ago. Impressed with its magnitude, European travelers in the 17th century probably first used the name. The Chinese called it the "10,000 Li Long Wall." A li was a unit of length equal to about one-third of a mile. However, this name did not represent an actual measurement, but was merely a poetic way of expressing the wall's vast length.

To Keep Out the Barbarians

By the 8th century B.C.E., the Chinese were already experts at wall building. Their sturdy walls were constructed by pounding layers of earth and stones inside wooden frames. These walls marked the boundaries of homes, villages, and independent Chinese kingdoms. Some of the walls were hundreds of miles long. When the Qin emperor Shi Huangdi conquered and unified these kingdoms in 221 B.C.E., he ordered most of the walls torn down, but left standing the sections of wall along China's long northern border.

North of the border were nomadic herding tribes. Now and then, they would invade China's territory, which earned them the reputation of "barbarians," or savages, among the Chinese. Qin Shi Huangdi demanded that a new wall be built to connect the remaining wall sections and keep the raiders out. This structure was the first "Great Wall of China."

Chinese records mention this initial portion of the Great Wall. Legends describe the hundreds of thousands of workers who were forced to leave their homes to build the first wall, but no documented details exist about how long it was or what route it followed. Very few parts of this wall remain. It is likely that the sections were made of local materials to lower the cost of transporting building supplies. Stone was used where it was available, but otherwise, pounded earth was used as the building material.

The wall was only as strong as China's ability to defend it. Invading "barbarians" could not drive their herds through it or jump their horses over it. However, enemies sometimes broke through the wall to launch raids. Later dynasties repaired, rebuilt, and added more sections of the wall. In the 13th century, the Mongols conquered China by going around the wall and attacking from the south and east.

The Ming dynasty regained control of China in 1368, but wars with the Mongols continued. Finally, the Ming emperors decided to erect new walls along the northern border. Initially, the walls were built in the traditional style of pounded earth, but by the 16th century, the Ming were building with brick and stone. They took particular care to fortify the wall north of their capital, Beijing, where the wall averaged 26 feet in height and up to 30 feet in width. Soldiers could march along the top. There were guard towers at every peak, dip, and turn. The guards could send signals from tower to tower. Messages distributed this way could travel 26 miles per hour, faster than a galloping horse.

Unfortunately, even this wall could not stop a determined enemy. In 1644, the "barbarian" Manchus broke through and conquered China. Their land in the north was merged with that of the Chinese empire, so there was no longer a need for a defensive wall. Neglected, the Great Wall of China began to fall into ruin.

Crumbling Walls

In 1912, when the last Manchu emperor was overthrown and China became a republic, the Chinese began to take pride in their walls. But by then, many sections of the wall that the Ming built were gone. In

fact, actions taken by the Ming had hastened damage to their huge construction project.

As the new walls were under construction, Ming emperors were clearing the forest and the grasslands for 60 miles on either side of the wall. On the north side, this was completed so that enemies could not launch a surprise attack. On the south side, the area was planted with crops to feed the soldiers. The cleared land gradually became desert. Long stretches of wall were buried by drifting sand and harsh winds tearing stones from the wall's tops and sides. In mountainous areas, the cleared land was eroded by floods, which undermined the base of the wall and caused sections to collapse.

Human activity has also damaged the wall. Farmers excavated stones to use as building material and hauled away packed earth to develop their fields. Modern industry has taken its toll as well. Pollution from factories has further eroded the wall. One section of the wall was blasted away so that a highway could pass through. Another gap was created so trucks could transport gravel from a nearby quarry.

In other places, the wall hasn't been destroyed as much as treated with disrespect. Tourists scribble graffiti on it, and picnickers litter it with trash. In 2006, golfers shot balls from the wall to advertise a golf tournament. All-night dance parties have occurred on it. Government officials have argued over who has the right to collect tourist fees.

Preserving the Walls

Fortunately, some people in China have taken it upon themselves to save certain sections of the wall. The Chinese government has begun paying more attention to this national treasure, too.

The movement to preserve the wall began with the people who lived nearby. Some residents are descended from the families once forced by Ming emperors to move to different locations for the construction of the wall. Today, these people patrol sections of the wall to protect it from further damage. The Chinese government pays them a small amount of money for this effort.

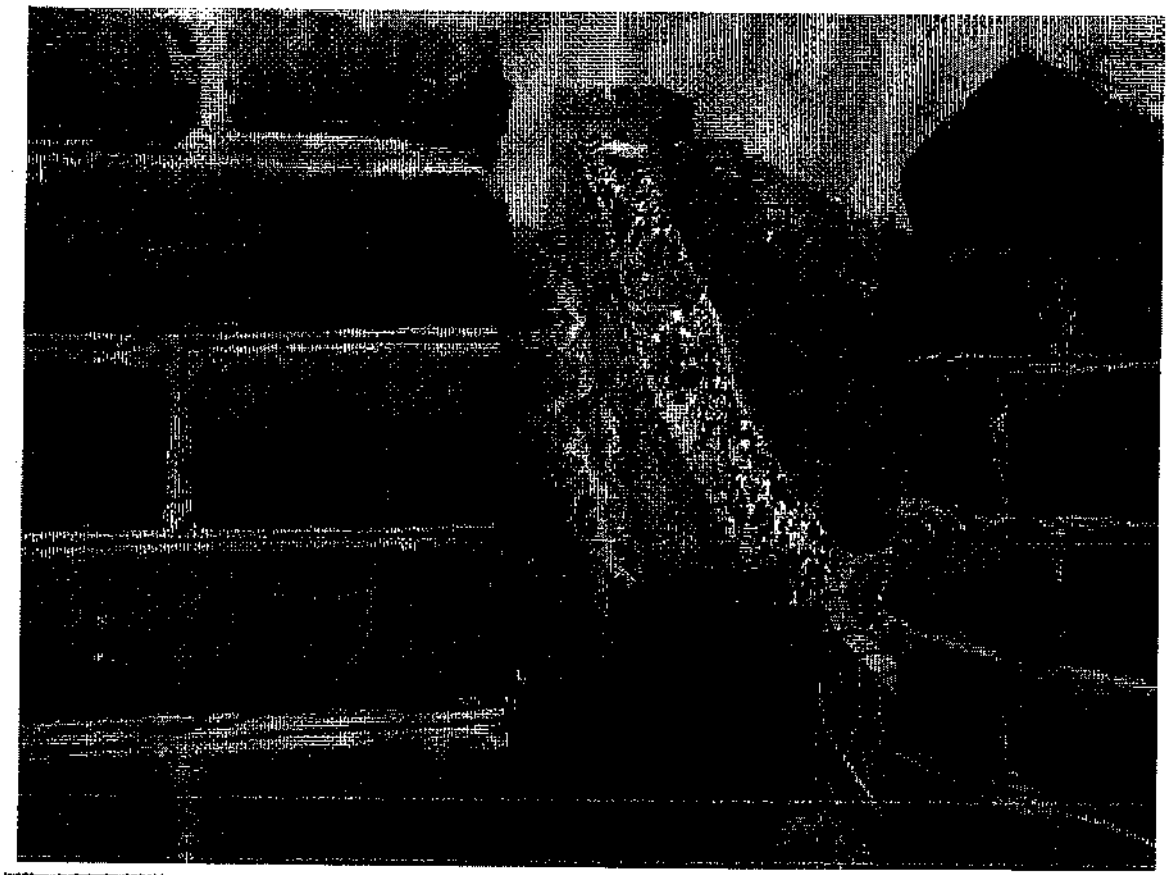
In 2006, the government passed laws to protect the wall. Anyone caught bulldozing away sections of it or damaging it in other ways may have to pay a fine. However, China is an enormous country, and the wall is long, so it is difficult to monitor the entire structure. Additionally, officials are poorly paid, and there are not enough of them to enforce the laws. For example, even though companies are fined for blasting

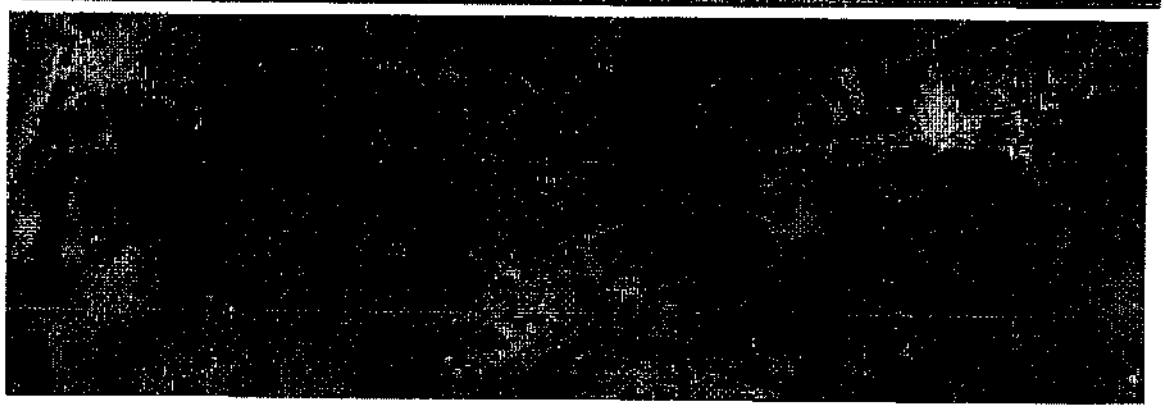
holes in the wall, many have already caused significant damage.

Can You See the Great Wall from Space?

Now, what about those stories about the Great Wall being visible from space? Such claims have often been repeated. However, people were making that statement as early as 1754—more than 200 years before humans first went into space. No astronaut ever confirmed that the Great Wall could be seen by the human eye from space. However, it can easily be seen in radar images taken from space. The Great Wall's steep, smooth sides provide a good surface for reflecting radar beams.

The best way to get a good view of the Great Wall would be to go to China and visit it. Then you would be able to appreciate why Chinese people want to preserve the Great Wall—and what an extraordinary monument it is to human achievement.





The Rise of the Mongol Dynasty

At the start of the 13th century, the Mongols were a collection of separate tribes that roamed the grasslands north of present-day China. But by the end of the century, they had taken over China, as well as much of Eurasia, to become one of the largest empires the world had ever seen. How did this empire grow so large? And who led this great expansion?

The Mongol empire is best known for the leaders' brutal war tactics that drove expansion. The first military campaigns were led by a man

named Genghis Khan (GEHNG-guh-SKAHN), born with the name Temujin. Khan united the Mongol tribes in the early 13th century, which began the creation of an empire.

As you read, you will learn about Khan's ruthless war tactics and intensely loyal subjects. You will also discover how his descendants brought the Mongol empire to its peak and, eventually, to its demise.

Rise Under Genghis Khan

Temujin was born in 1162 in present-day Mongolia. According to a Mongolian legend, he was born holding a clot of blood, which was believed to be a sign of future success. However, he faced a difficult upbringing. When Temujin was only nine, his father was poisoned by a rival clan. After this tragedy, Temujin's clan (called the Borjigin) abandoned him and his family, believing them to be weak. For a long time, the family was extremely poor.

From a young age, Temujin attracted followers. One ancient Mongolian story tells of thieves that stole all but one of Temujin's horses during the night. He went out after them using the only horse left. Along the way, he met a man on the side of the road named Bo'orchu. Seeing promise in Temujin, Bo'orchu gave him a new horse and pledged his service for free.

Though Temujin and his family were poor, they still had some ties the Borjigin, who happened to be the royal clan of the Mongols. At age ten, Temujin claimed a wife and began climbing the ranks of the clan. His natural ability to attract supporters helped him make powerful allies. One friend in particular, Toghril, who was the khan (leader) of a different clan, proved to be especially valuable. In exchange for a prized animal skin, Toghril supplied Temujin with 20,000 men for an army. This was the start of Temujin's rise to power.

With his army, Temujin killed many rival leaders and even members of his own clan. His battle strategy was to take out anyone who he felt was a possible threat. Historians estimate that he and his troops killed as many as 40 million people while he was in power. This brutal tactic helped grow his army, for every time he defeated a clan, he would add the remaining people to his own.

Another strategy he used to maintain his power was placing his family in positions of authority, for they were unlikely to betray him. Eventually, he became the strongest leader in Mongolia. By 1206, Temujin ruled over all the clans.

When he took power, Temujin was given the title of Genghis Khan, which is thought to mean "Universal Ruler." This moment is recognized as the start of the Mongol dynasty.

Expanding the Empire

Under Khan's military genius, the Mongols achieved victory after victory, fighting their first battles against the Western Xia (located in modern-day China and Tibet). Initially, the Mongol army only used cavalry (men on horseback) to fight. Their most effective battle tactic was to shoot enemies with arrows as they rode on their horses.

Later, when they seized major cities, Khan had to adapt his strategy since horses could not get over large walls. His advanced tactics included catapults, hot oil, and ladders for climbing walls.

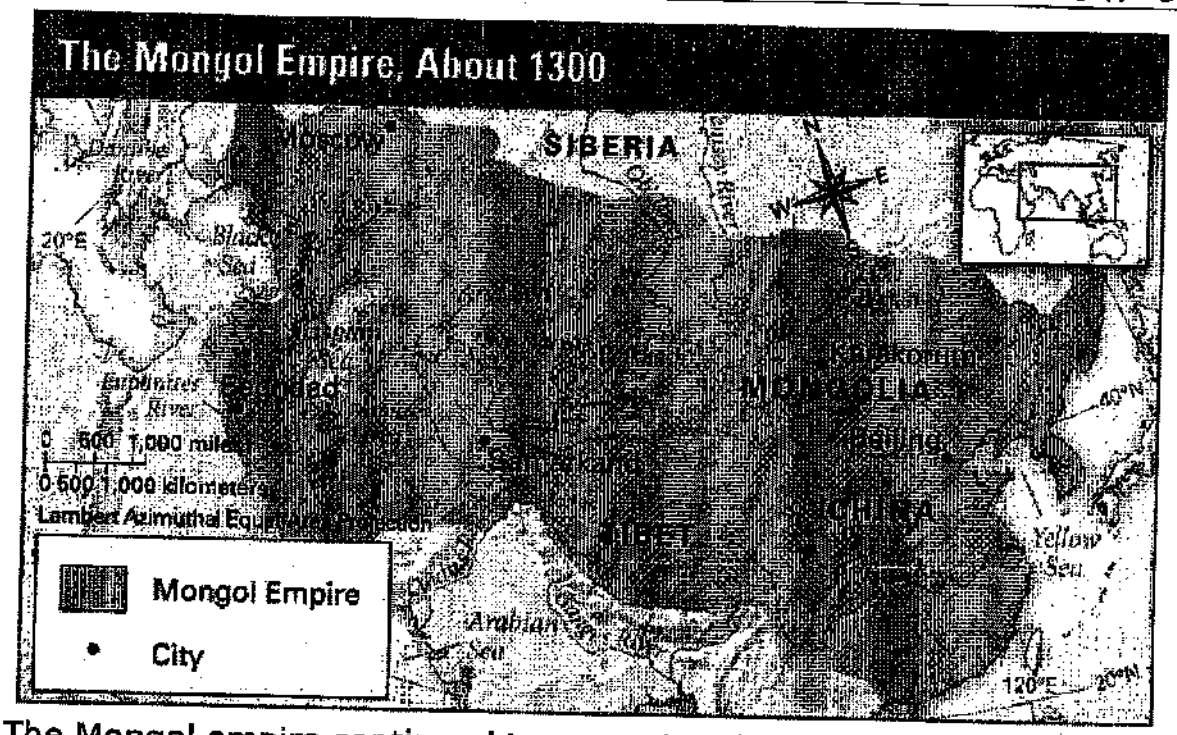
When the Mongols raided cities, they usually destroyed them. At first, the Mongols didn't realize that captured cities offered resources and protection. It was only later in Khan's rule that, with the guidance of his advisors, he stopped completely destroying enemy cities. His destructive behavior gave the Mongols a reputation as brutal, lawless conquerors. One 13th-century British historian named Matthew Paris described them as a "detestable nation of Satan."

Because of Khan's military leadership, the Mongols were able to defeat armies that were much larger than theirs. Two examples of this are the Khwarezm (from present-day Iran) and Jin (from present-day North China) empires.

Over time, Khan learned that there was more to conquering lands than looting and destroying. Advisors from Khwarezm taught him the "meaning and importance of towns." Another advisor from Jin explained that peasants and craftsmen could be used to make products for the empire and that fields could be used to grow crops. Both pieces of advice stopped Khan from committing some of his atrocities.

Khan died on a campaign in 1227. By this time, the Mongol empire stretched from Beijing (in North China) to the Caspian Sea (near Italy), and north into Russia. Before he died, Khan ensured that his empire would continue, choosing his son, Ogodei, to rule after him. Though it was the end of the great military leader's life, his empire had yet to grow to its largest size.

The Rule of Kublai Khan



The Mongol empire continued to expand under the rule of Ogodei. Upon his death in 1241, the grandsons of Genghis fought for control. First, Mongke became the great khan, and then Kublai Khan. It was under Kublai's rule that the empire reached its peak.

Ruling from 1260-1294, Kublai's greatest accomplishment was conquering all of China (Genghis had only conquered the northern part). This made Kublai the first khan to rule all of China as well as the Mongolian empire (including southern Russia, present-day Iran, and the Mongol heartland).

But ruling China was not easy. As one of Kublai's advisors said, "I have heard that one can conquer the empire on horseback, but one cannot govern it on horseback." This meant that the ways of the Mongols were very different from the ways of the Chinese. Kublai would have a hard time ruling a people whose ways he didn't understand. Kublai realized this and gathered a trusted group of Confucian advisors from China to help him rule.

Not only did Kublai rule China, but he unified the country for the first time in over 300 years. This achievement was considered even more impressive because he was not native to China.

Kublai's success in China was evidence that he was an effective ruler. His reputation also benefitted from publicity by Marco Polo, an Italian explorer. Polo wrote a book called *Il milione* about his adventures, which included travelling to China and spending time with Kublai Khan.

Polo catalogued and praised Kublai's rule heavily, giving him a favorable reputation.

In addition to creating the largest empire the Mongols would ever have, Kublai is celebrated for his use of paper money. Though he was not the first ruler to use it, he was the first to make it the only form of currency.

However, it is worth noting that Kublai's rule in China was not without some problems. For one, China's population dropped in half during the 50 years of Mongol occupation. This is likely due to the brutal war tactics and deaths employed by Genghis and then passed on to his kin, including Kublai.

Another problem Kublai had was his admiration with Chinese culture. Kublai moved the headquarters of his empire to Beijing. There, he adopted many Chinese practices and customs. While this strengthened ties with China, it angered other leaders in the Mongol empire.

Overall, Kublai's rule made China very prosperous, but he lost touch with the rest of the Mongol empire. He even fought with other Mongols during his ruled. After his reign, the Mongol empire did not survive for very long. Kublai Khan died in 1294, and the empire dissolved in 1368.

The Mongol dynasty dissolved for multiple reasons. Among them was that power was no longer as controlled as it was under Genghis. Rather than being all in the family, it was given to foreign advisors and bureaucrats. Another factor is that lower-ranking leaders, called *Khanates,* frequently fought amongst each other, which weakened the empire. The Mongol empire is marked to end when China was recaptured from the Mongols by the Ming dynasty in 1368.

However, the Mongol expansion left a lasting legacy on the regions that the dynasty had ruled. From the Caspian Sea to the coast of China, Mongols left their mark by settling in the civilizations they conquered. Using genetic testing, scientists can show that many modern people throughout Eurasia have Mongol genes.

For better or worse, Genghis Khan's ambition and leadership changed the course of history for a large portion of the world. Perhaps the greatest achievement of Genghis and his ancestors was the single, unified Mongolian culture he helped create. However, this culture came at the price of many deaths. Even though the vast Mongolian empire has long since fallen, aspects of Mongolian culture still endure today.