WASL - Washington Assessment of Student Learning

A Component of the Washington State Assessment System

Mathematics High School

Sample Items
Teacher Materials

Dr. Terry Bergeson
State Superintendent of
Public Instruction

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A Letter from the Superintendent

September 30, 2008

Dear Washington Educators:

I am delighted to offer this publication of sample high school mathematic items from the Washington Assessment of Student Learning. I hope you find these materials helpful in your efforts to improve instruction and increase student learning.

These sample items are from our bank of high school WASL items. The items we are sharing with this release have not appeared on a previous test, but they have all been through every step of the two-year item development and review cycle. Every item has passed our quality checks and was eligible to be used on a future high school test. We have decided to release these items and make them available to assist you and your students in gaining a deeper understanding of the kinds of things we are asking our students to know and be able to do.

This document is also available on our Web site, which offers the option to print sections individually.

I encourage you to join with other staff to work with the item-specific scoring guides and the annotated student responses that illustrate each score point. Schools that have used this process in the past have given us positive feedback about this experience.

Please visit our Web site (www.k12.wa.us) for additional resources to guide your instructional practices. I wish you the best for the remainder of this school year as we continue our work together to ensure all students have the skills needed to be successful today and in the future.

Sincerely,

Dr. Terry Bergeson
State Superintendent of Public Instruction

How to Use this Sample Item Booklet

This document should be used to help administrators and teachers understand sample WASL items that reflect content-specific learning strands and targets that are derived from the Essential Academic Learning Requirements.

This **Sample Item Booklet** includes the following information:

- WASL Mathematics items from the High School operational item bank
- A tools designation that shows whether the item could be placed on the assessment in a location on a day when tools are permitted (Y), on a day when tools are not permitted (N), or the day the item is placed does not matter (X).
- Information to indicate the strand and/or learning target information for each item
- Item-specific scoring guides, student work at representative score points, and annotations for scores.

Introduction to High School Mathematics Sample Items

Welcome to the Sample Item Booklet for High School mathematics. In this booklet you will find ten items that were part of the High School item bank for mathematics.

There are three types of assessment items for High School included in this document:

- Multiple-choice questions where students earn one point by selecting the right answer from four options
- Short-answer items where students earn up to two points by writing an answer, explaining their thinking, drawing a picture or diagram, or showing steps used to solve a problem
- Extended-response items where students earn up to four points by constructing a response that asks for more details (graphs, tables, written summaries) or more thinking.

These sample items provide opportunities for teachers and administrators to become experienced with the item-specific scoring guides and annotated samples of student responses.

As you study the items, you may want to become familiar with the WASL test and item specifications and grade level expectations (located on our website—www.k12.wa.us), and the annotated student responses contained in this Sample Items booklet. Each item in this booklet represents a "learning target," which is a mathematics skill derived from the Essential Academic Learning Requirements (EALRs) that can be captured in a paper and pencil assessment. These targets are subsets of the nine mathematics content and process strands.

In order to assist you in your efforts in understanding and using the Sample Items booklet, please do not hesitate to search our website www.k12.wa.us for further resources.
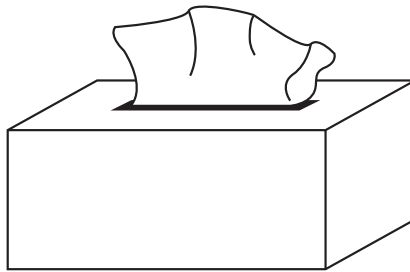
Sincerely,

Yoonsun Lee (360) 725-6291
Director of Assessment and Psychometrics

Mary Holmberg	(360) 725-6235	3rd, 4th, and 5th grade
Lynda Eich	(360) 725-4974	6th, 7th, and 8th grade
Robert Hodgman	(360) 725-6440	High School
Karen Hall	(360) 725-4962	

2008 Mathematics Sample Items

1 A tissue can be 0.000075 meters thick.

Which expression represents 0.000075 in scientific notation?

○ **A.** 7.5×10^{5}

○ **B.** 7.5×10^{-5}

○ **C.** 75×10^{6}

○ **D.** 75×10^{-6}

27089

Item Information

Score Points: 1

Key: B

Tools: N

Strand and Target NS01 (Number and Numeration): Demonstrate understanding of the concepts and symbolic representations of rational numbers including whole number powers, square roots of perfect squares, and numbers written in scientific notation; demonstrate understanding of the relative values of rational numbers including whole number powers and square roots of perfect squares; demonstrate understanding of and use the distributive property and properties of addition and multiplication with rational numbers including integers (1.1.1, 1.1.2, 1.1.3)

2 Tina drove 100 miles in the first 2 hours and then drove 200 more miles in the next 5 hours.

What was her approximate average speed for the entire trip?

○ **A.** 40 miles per hour

○ **B.** 43 miles per hour

○ **C.** 45 miles per hour

○ **D.** 50 miles per hour

04074

Item Information

Score Points: 1

Key: B

Tools: N

Strand and Target ME02 (Units and Systems): Demonstrate understanding of rate and other derived units of measurement; demonstrate understanding of how to convert within the US or metric system to achieve an appropriate level of precision; explain why different situations require different levels of precision (1.2.2, 1.2.3)

3 A 10 cm × 10 cm × 10 cm wooden block is painted red on all of its faces. It is then cut into cubes, 1-cm on each edge.
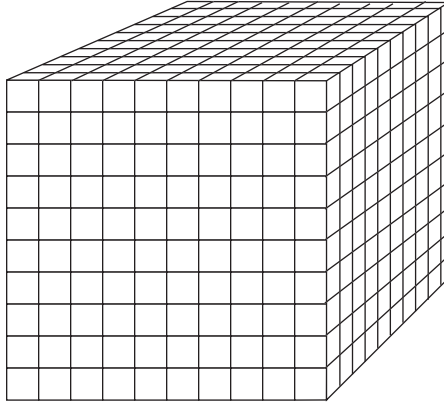
How many cubic centimeter pieces have exactly 2 faces painted?

○ **A.** 64

○ **B.** 96

○ **C.** 100

○ **D.** 104

03176

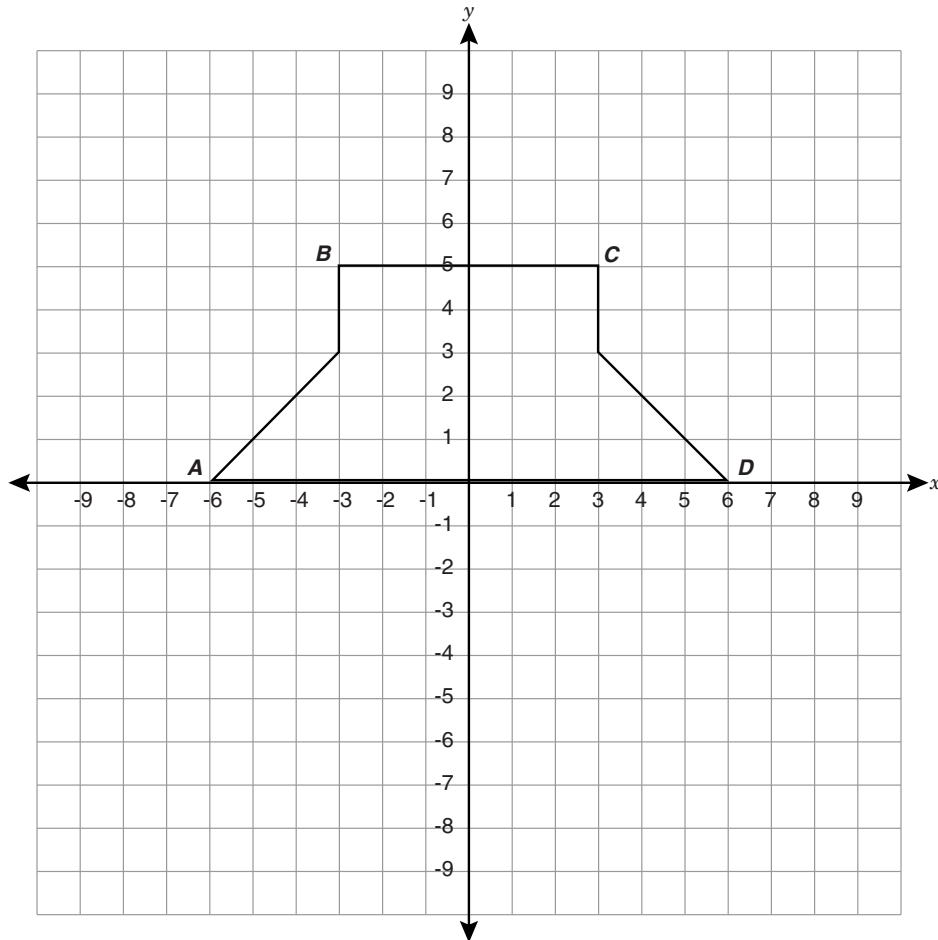**Item Information**

Score Points: 1

Key: B

Tools: X

Strand and Target GS01 (Properties and Relationships): Demonstrate understanding of the characteristics of cylinders, cones, and pyramids and the relationships among 1-dimensional, 2-dimensional, and 3-dimensional figures; draw, describe, and/or compare 1-dimensional, 2-dimensional, and 3-dimensional shapes and figures, including prisms, cylinders, cones, and pyramids; use the Pythagorean Theorem to determine if a triangle is a right triangle (1.3.1, 1.3.2)

4 When the figure below is rotated 90° **counterclockwise** about the origin, what would be the new coordinates of point C?

○ **A.** $(-5, 3)$

○ **B.** $(3, -5)$

○ **C.** $(5, -3)$

○ **D.** $(5, 3)$

00896

Item Information

Score Points: 1

Key: A

Tools: X

Strand and Target GS02 (Locations and Transformations): Use geometric properties to describe or identify the location of points on coordinate grids; use multiple transformations including translations, reflections, and/or rotations to create congruent figures (1.3.3, 1.3.4)

5 In a certain game, the contestants shut their eyes and draw either a shaded cube or a white cube from a box. A contestant cannot return the cube after drawing it from the box. The box contains the cubes shown in the diagram.
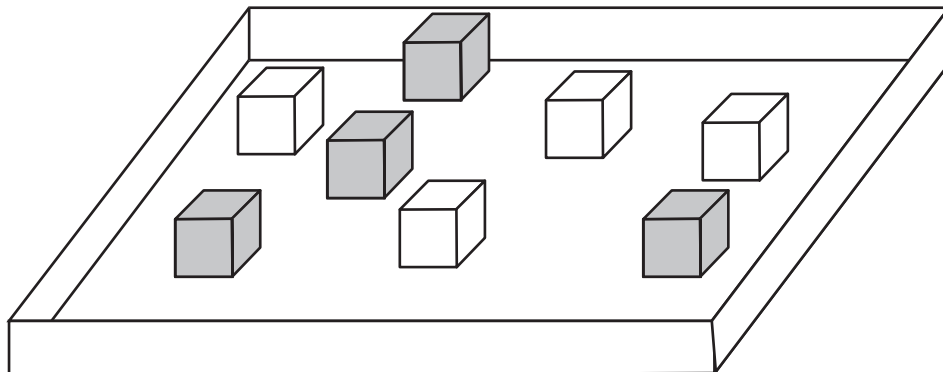
What is the probability that a contestant will draw a shaded cube on 2 consecutive draws?

○ **A.** $\frac{3}{14}$

○ **B.** $\frac{1}{4}$

○ **C.** $\frac{1}{2}$

○ **D.** $\frac{7}{15}$

03516

Item Information

Score Points: 1

Key: A

Tools: X

Strand and Target PS01 (Probability): Demonstrate understanding of the concepts of compound, dependent and independent events; determine and use probabilities of compound, dependent, and independent events (1.4.1, 1.4.2)

6 Two-hundred items were sold at a snack stand for a total of $130.00. The only items sold were cans of pop for $0.50 and bags of popcorn for $0.75.

How many of each item were sold?

○ **A.** 120 cans of pop, 80 bags of popcorn

○ **B.** 80 cans of pop, 120 bags of popcorn

○ **C.** 160 cans of pop, 40 bags of popcorn

○ **D.** 40 cans of pop, 160 bags of popcorn

21371

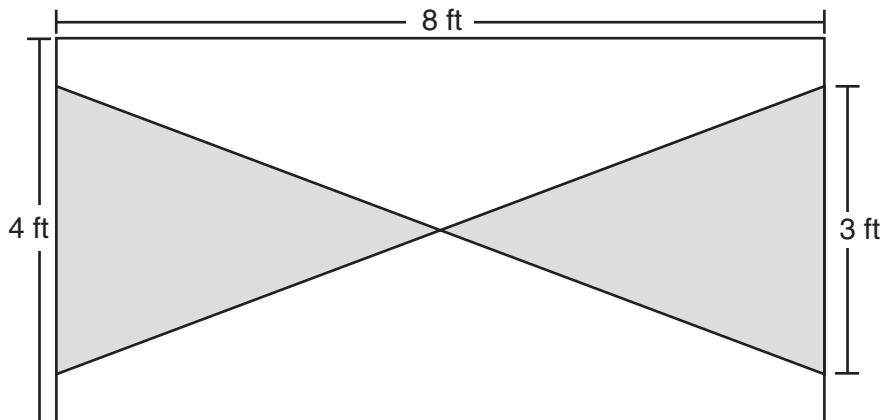### Item Information

Score Points: 1

Key: B

Tools: X

Strand and Target AS03 (Evaluating and Solving): Simplify expressions; solve multi-step equations, systems of equations, and one-step inequalities (1.5.5, 1.5.6)

7 Donna created two congruent pentagons from a rectangular piece of plywood by removing the two shaded triangles.

Which percent represents the amount of the rectangular piece of plywood used for the pentagons?

○ **A.** 25.00%

○ **B.** 37.50%

○ **C.** 50.00%

○ **D.** 62.50%

27741

Item Information

Score Points: 1

Key: D

Tools: Y

Strand and Target MC01 (Connections within Mathematics): Use concepts and procedures from multiple mathematics content strands in a given problem or situation; relate and use different mathematical models and representations of the same situation (5.1.1, 5.1.2)

8 An electrician told Mrs. Aba that the labor required to repair the electrical problem cost $150. The bill included a base service call charge of $40 plus $25 per hour.

- Without solving, write an equation that could be solved to determine the number of hours the electrician worked.

- Indicate what the variable represents.

02706

Item Information

Score Points: 2

Tools: X

Strand and Target AS02 (Symbols and Notations): Represent relationships between quantities using squares, cubes, and square roots; use variables to write expressions, linear equations, and inequalities that represent situations involving rational numbers, whole number powers, and square and cube roots (1.5.3, 1.5.4)

Scoring Guide for item number 8

A 2-point response: The student demonstrates understanding of writing equations to represent situations that involve variable quantities by doing the following:

- writes an equation that could be solved to determine the number of hours the electrician worked
- indicates the variable represents hours.

> NOTE: Allow for one transcription error.

> NOTE: 'Per hour' is not an acceptable indication that the variable represents hours.

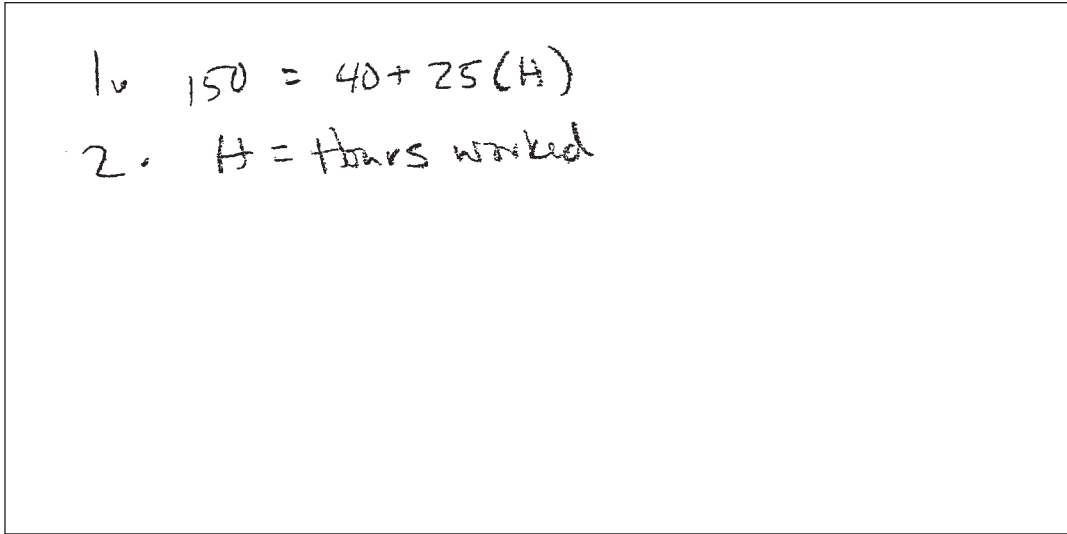A 1-point response: The student does <u>one</u> of the following:

- writes an equation that could be solved to determine the number of hours the electrician worked, but does not indicate the variable represents hours
- writes an expression or incorrect equation but indicates the variable represents hours

A 0-point response: The student demonstrates very little or no understanding of writing equations to represent situations that involve variable quantities.

8 An electrician told Mrs. Aba that the labor required to repair the electrical problem cost $150. The bill included a base service call charge of $40 plus $25 per hour.

- Without solving, write an equation that could be solved to determine the number of hours the electrician worked.

- Indicate what the variable represents.

1. $150 = 40 + 25(H)$
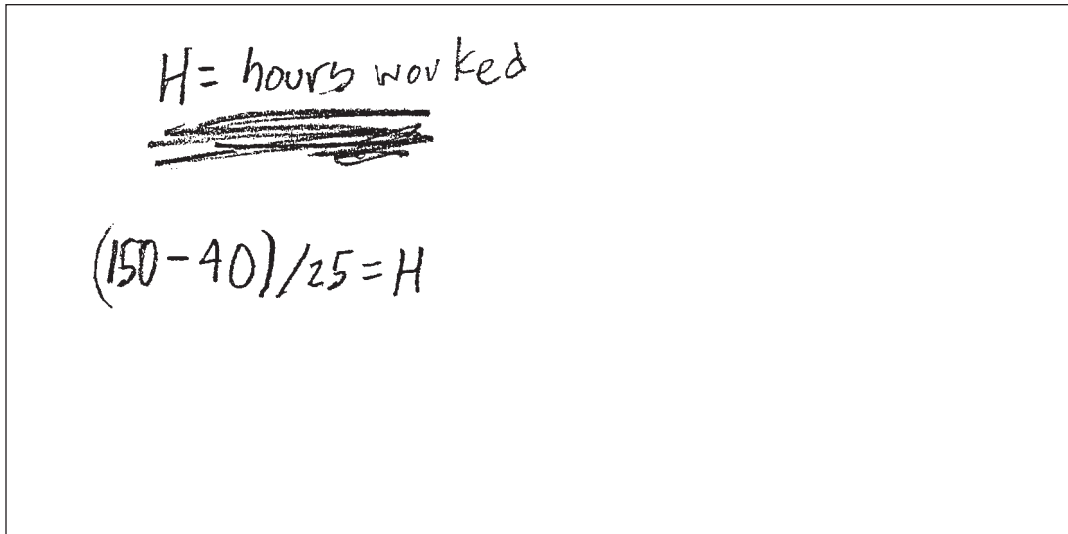
2. $H = $ Hours worked

02706

Annotated example for a 2-point response for question number 8:

The student shows understanding of writing an equation to represent a situation that involves a variable quantity by writing "*150 = 40 + 25(H),*" an equation that could be solved to determine the number of hours the electrician worked. The student indicates the variable in the equation represents the hours worked by writing "*H = Hours worked.*" This response earns two points.

15

8 An electrician told Mrs. Aba that the labor required to repair the electrical problem cost $150. The bill included a base service call charge of $40 plus $25 per hour.

- Without solving, write an equation that could be solved to determine the number of hours the electrician worked.

- Indicate what the variable represents.

$$H = hours\ worked$$

$$(150 - 40)/25 = H$$

02706

Annotated example for a 2-point response for question number 8:

The student shows understanding of writing an equation to represent a situation that involves a variable quantity by writing *"(150 – 40)/25 = H,"* an equation that could be solved to determine the number of hours the electrician worked. The student indicates the variable represents the hours worked by writing *"H=hours worked."* This response earns two points.

8 An electrician told Mrs. Aba that the labor required to repair the electrical problem cost $150. The bill included a base service call charge of $40 plus $25 per hour.

- Without solving, write an equation that could be solved to determine the number of hours the electrician worked.

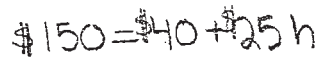- Indicate what the variable represents.

02706

Annotated example for a 2-point response for question number 8:

The student shows understanding of writing an equation to represent a situation that involves a variable quantity by writing "*(150-40)/25=H*," an equation that can be solved to determine the number of hours the electrician worked, and crossing it out to write "*x=(c-b)/h*." The student indicates the variable *x* represents the hours worked by writing "*x = # of hrs*." The variables *c*, *b*, and *h* are also defined correctly. This response earns two points.

8 An electrician told Mrs. Aba that the labor required to repair the electrical problem cost $150. The bill included a base service call charge of $40 plus $25 per hour.

- Without solving, write an equation that could be solved to determine the number of hours the electrician worked.

- Indicate what the variable represents.

$$\$150 = \$40 + \$25\,h$$

02706

Annotated example for a 1-point response for question number 8:

The student shows partial understanding of writing an equation to represent a situation that involves a variable quantity by writing "*$150 = $40 + $25h,*" an equation that could be solved to determine the number of hours the electrician worked. The student does not define what "*h*" represents. This response has a correct equation without a defined variable. This response earns one point.

8 An electrician told Mrs. Aba that the labor required to repair the electrical problem cost $150. The bill included a base service call charge of $40 plus $25 per hour.

- Without solving, write an equation that could be solved to determine the number of hours the electrician worked.

- Indicate what the variable represents.

$$150 + 40 + 25x = y$$

$$x = \text{number of hours}$$
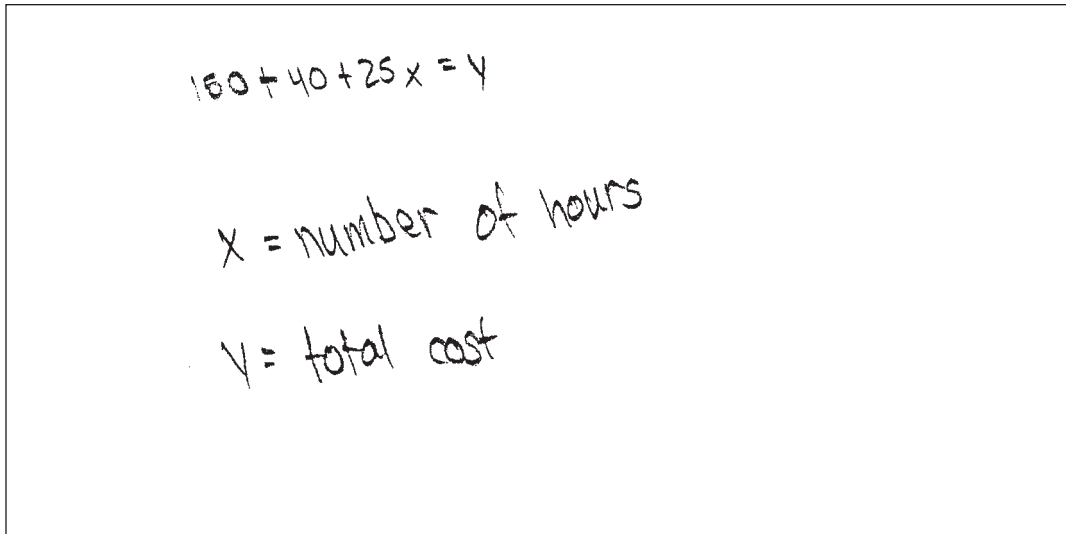
$$y = \text{total cost}$$

02706

Annotated example for a 1-point response for question number 8:

The student shows partial understanding of writing an equation to represent a situation that involves a variable. The equation "*150 + 40 + 25x = y*" is incorrect. The student indicates the variable *x* represents the hours worked by writing "*x=numbers of hours.*" The response has an incorrect equation but a correctly defined variable. This response earns one point.

8 An electrician told Mrs. Aba that the labor required to repair the electrical problem cost $150. The bill included a base service call charge of $40 plus $25 per hour.

- Without solving, write an equation that could be solved to determine the number of hours the electrician worked.

- Indicate what the variable represents.

$$40 + (n \cdot 25)$$

$$n = \text{number of hours worked}$$

Annotated example for a 1-point response for question number 8:

The student shows partial understanding of writing an equation to represent a situation that involves a variable. The expression "*40 +(n·25)*" is correct but not an equation. The student indicates the variable *n* represents the hours worked by writing "*n = number of hours worked.*" The response has an expression, not an equation, and a correctly defined variable. This response earns one point.

8 An electrician told Mrs. Aba that the labor required to repair the electrical problem cost $150. The bill included a base service call charge of $40 plus $25 per hour.

- Without solving, write an equation that could be solved to determine the number of hours the electrician worked.

- Indicate what the variable represents.

$$\frac{150-40}{25} = \frac{110}{25} = 4.4 \text{ hours}$$

02706

Annotated example for a 0-point response for question number 8:

The student shows little or no understanding of writing an equation to represent a situation that involves a variable quantity. The student manipulates the numbers to determine correctly the number of hours worked but is off prompt. This response earns zero points.

9 A certain school has 12 mathematics teachers and only 3 types of mathematics courses—algebra, geometry, and calculus. Two of the teachers teach only algebra. Eight teachers teach geometry, and six teach calculus.

How many teachers teach both geometry and calculus?

Clearly explain or show how you arrived at your answer.

How many teachers teach both geometry and calculus? _____

01066

Item Information

Score Points: 2

Tools: X

Strand and Target SR02 (Construct Solutions): Select and organize relevant information; use appropriate concepts and procedures from number sense, measurement, geometric sense, probability and statistics, and algebraic sense; use a variety of strategies and approaches; determine whether a solution is viable, mathematically correct; and answers the question(s) asked (2.2.1, 2.2.2, 2.2.3, 2.2.4)

Scoring Guide for item number 9

A 2-point response: The student demonstrates understanding of selecting and using relevant information and an appropriate strategy to determine an answer by doing the following:

- indicates 4 teachers teach both geometry and calculus
- provides an explanation (written, algebraic, or diagrammatic) for the answer.

    NOTE: Allow for one computation or transcription error that does not affect the answer.

A 1-point response: The student does <u>one</u> of the following:

- indicates 4 teachers teach both geometry and calculus, but the explanation is flawed, incomplete, or missing
- provides work showing either 2 calculus teachers do not teach geometry or 4 geometry teachers do not teach calculus
- demonstrates an appropriate procedure to determine how many teachers teach both geometry and calculus, but an error in the process results in an incorrect answer.

A 0-point response: The student demonstrates very little or no understanding of selecting and using relevant information and appropriate strategy to determine an answer.

9 A certain school has 12 mathematics teachers and only 3 types of mathematics courses—algebra, geometry, and calculus. Two of the teachers teach only algebra. Eight teachers teach geometry, and six teach calculus.

How many teachers teach both geometry and calculus?

Clearly explain or show how you arrived at your answer.

How many teachers teach both geometry and calculus? ___4___

01066

Annotated example for a 2-point response for question number 9:

The student demonstrates understanding of selecting and using relevant information and an appropriate strategy to determine an answer by writing "*4*" teachers teach both geometry and calculus and providing a diagram to show 2 teachers teach algebra, 8 teach geometry, 6 teach calculus and the overlap of 4 teachers who teach both geometry and calculus. This response earns two points.

9 A certain school has 12 mathematics teachers and only 3 types of mathematics courses—algebra, geometry, and calculus. Two of the teachers teach only algebra. Eight teachers teach geometry, and six teach calculus.

How many teachers teach both geometry and calculus?

Clearly explain or show how you arrived at your answer.

$$(8-x) + (6-x) + x = 10$$
$$8 - x + 6 - x + x = 10$$
$$-x = -4$$
$$x = 4$$

How many teachers teach both geometry and calculus? ___4___

01066

Annotated example for a 2-point response for question number 9:

The student shows understanding of selecting and using relevant information and an appropriate strategy to determine an answer by writing "*4*" teachers teach both geometry and calculus, and providing an algebraic explanation "*(8 − x) + (6 − x) + x = 10*" and solving the equation correctly. This response earns two points.

9 A certain school has 12 mathematics teachers and only 3 types of mathematics courses—algebra, geometry, and calculus. Two of the teachers teach only algebra. Eight teachers teach geometry, and six teach calculus.

How many teachers teach both geometry and calculus?

Clearly explain or show how you arrived at your answer.

2 only algebra
8 geometry
6 calculus
16
-12 teachers
4

How many teachers teach both geometry and calculus? ___4___

Annotated example for a 2-point response for question number 9:

The student demonstrates understanding of selecting and using relevant information and an appropriate strategy to determine an answer by writing "*4*" teachers teach both geometry and calculus, and providing a strategy showing that there are 16 classes and only 12 teachers. This response earns two points.

9 A certain school has 12 mathematics teachers and only 3 types of mathematics courses—algebra, geometry, and calculus. Two of the teachers teach only algebra. Eight teachers teach geometry, and six teach calculus.

How many teachers teach both geometry and calculus?

Clearly explain or show how you arrived at your answer.

2   8   6

6 − 2 = 4 − 8 = 4

How many teachers teach both geometry and calculus? ____4____

01066

Annotated example for a 1-point response for question number 9:

The student demonstrates partial understanding of selecting and using relevant information and an appropriate strategy to determine an answer by writing the correct number of teachers as "*4*" but the strategy is flawed. The explanation "*2*," "*8*," and "*6*" is a repeat of the prompt while "*6 – 2 = 4 – 8 = 4*" is an incorrect run-on equation. This response earns one point.

9 A certain school has 12 mathematics teachers and only 3 types of mathematics courses—algebra, geometry, and calculus. Two of the teachers teach only algebra. Eight teachers teach geometry, and six teach calculus.

How many teachers teach both geometry and calculus?

Clearly explain or show how you arrived at your answer.

	1	2	3	4	5	6	7	8	9	10	11	12
Geo	N	N	Y	Y	Y	Y	Y	Y	Y	Y		
Alg	Y	Y										
Cal	N	N				Y	Y	Y	Y	Y	Y	Y

How many teachers teach both geometry and calculus? ___5___

01066

Annotated example for a 1-point response for question number 9:

The student demonstrates partial understanding of selecting and using relevant information and an appropriate strategy to determine an answer by showing an appropriate strategy to determine how many teachers teach both geometry and calculus, but an error in the process results in an incorrect answer of "5." The diagram incorrectly shows that 7 teach calculus rather than the 6 stated in the problem. This response earns one point.
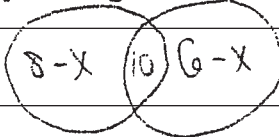
9 A certain school has 12 mathematics teachers and only 3 types of mathematics courses—algebra, geometry, and calculus. Two of the teachers teach only algebra. Eight teachers teach geometry, and six teach calculus.

How many teachers teach both geometry and calculus?

Clearly explain or show how you arrived at your answer.

Since two teachers teach only algebra there are ten geometry and calculus teachers Since $8+6=14$ and $14-10=4$ there must be two teachers who teach both geometry and calculus (using two instead of 4 accounts for the doubling up)

geometry   Calculus $(8-x)+(6-x)+10$
$14-2x \quad = 10$
$-2x \quad = -4$
$x = 2$

$8-x$ 10 $6-x$

How many teachers teach both geometry and calculus? _____2_____

01066

Annotated example for a 1-point response for question number 9:

The student demonstrates partial understanding of selecting and using relevant information and an appropriate strategy to determine an answer by showing an appropriate strategy to determine how many teachers teach both geometry and calculus, but an error in the process results in an incorrect answer of "*2.*" The student writes that there are ten geometry and calculus teachers and the equations "*8 + 6 = 14*" and "*14 – 10 = 4*" show the correct answer but the student does not use it. Instead the interpretation is "*using two instead of 4 accounts for the doubling up.*" The algebraic equation omits "*+x*" for the teachers who teach both geometry and calculus so the algebraic strategy is incorrect. This response earns one point.

9 A certain school has 12 mathematics teachers and only 3 types of mathematics courses—algebra, geometry, and calculus. Two of the teachers teach only algebra. Eight teachers teach geometry, and six teach calculus.

How many teachers teach both geometry and calculus?

Clearly explain or show how you arrived at your answer.

> If there are 10 teachers that don't only teach algebra then 1 of them teach both classes because if 5 just teaches calculus and 7 just teach geometry that will equal 12
>
> **How many teachers teach both geometry and calculus?** __1__

01066

Annotated example for a 0-point response for question number 9:

The student demonstrates very little or no understanding of selecting and using relevant information and an appropriate strategy to determine an answer by incorrectly writing "*1*" teacher teaches both geometry and calculus with no strategy to determine the answer. The student correctly identifies that "*10 teachers … don't only teach algebra*" but does not use the information. This response earns zero points.

10 Maria is observing bacterial growth in a science fair project. She put the bacteria in a petri dish and counted the number of bacteria. She then graphed the counts and drew a line to show the growth curve. The graph shows the population of the bacteria.
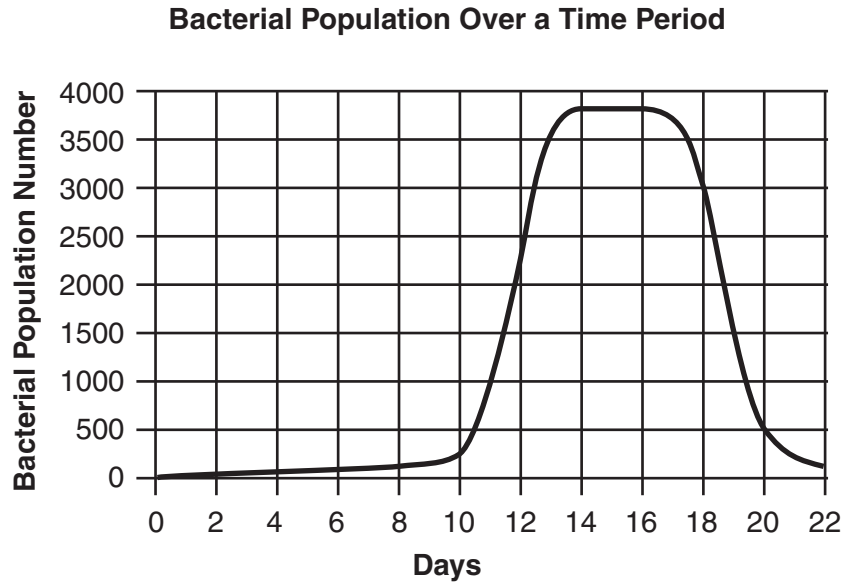
Bacterial Population Over a Time Period

Use the information from the graph and describe what happened to the bacteria over the entire time period.

Be sure to include:

- at least four population changes shown in the graph
- when each population change happened.

Additional work space

2008 Mathematics Sample Items

Item Information

Score Points: 4

Tools: X

Strand and Target CU01 (Gather Information): Develop or select an efficient system for collecting mathematical information for a given purpose; extract mathematical information for a given purpose from multiple sources using reading and observation (4.1.1, 4.1.2)

2008 Mathematics Sample Items
Scoring Guide for item number 10

A 4-point response: The student shows understanding of extracting and explaining mathematical information from a graph by doing the following:

Initial Growth

- identifies the time period ending at 9 or 10 days
- identifies the population count ending between 200 and 300, inclusive,
  or describes the change in population

Rapid Growth

- identifies the time period beginning at 9 or 10 days and ending at 13 or 14 days
- identifies the initial population between 200 and 300, inclusive, and the final
  population between 3700 and 3800, inclusive,
  or describes the change in population

No Growth

- identifies the time period beginning at 13 or 14 days and ending at 16 or 17 days
- identifies the population as a number between 3700 and 3800, inclusive,
  or identifies or shows that the population remains constant

Decline

- identifies the time period beginning at 16 or 17 days
- identifies or shows evidence the initial population is between 3700 and 3800, inclusive,
  and identifies the final population is between 50 and 500, inclusive,
  or describes the change in population.

NOTE: The mathematical language used to describe the graph must refer to the population of the bacteria. Points will not be given for descriptions that describe the movement of the curve.

A 3-point response: The student states three time periods and describes the changes in population during the time periods.

A 2-point response: The student states two time periods and describes the changes in population during the time periods.

A 1-point response: The student does <u>one</u> of the following:

- states one time period and describes the change in population during the time period
- states the 4 time periods
- describes the 4 changes, in sequence, in bacterial population
- creates a table or writes a description of a table that includes at least 5 data points.

A 0-point response: The student shows very little or no mathematical understanding of extracting and explaining mathematical information from a graph.

10 Maria is observing bacterial growth in a science fair project. She put the bacteria in a petri dish and counted the number of bacteria. She then graphed the counts and drew a line to show the growth curve. The graph shows the population of the bacteria.
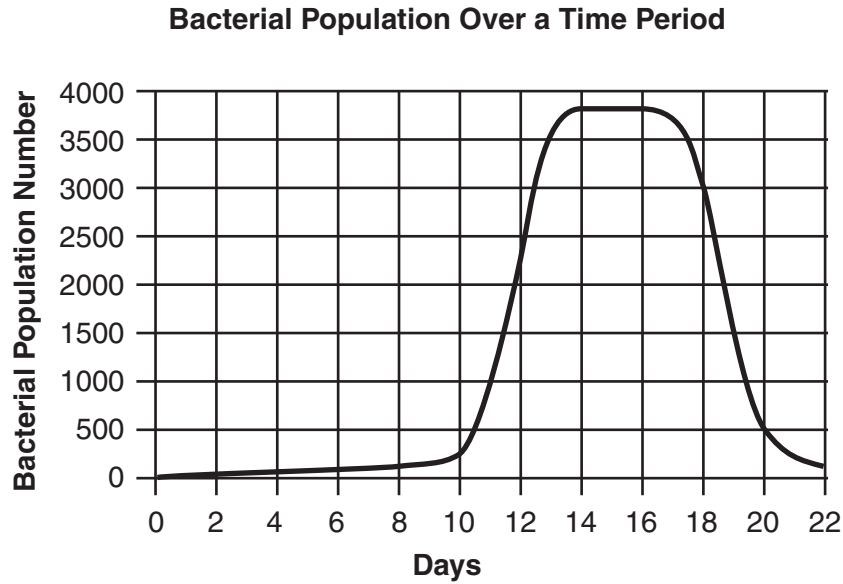
Bacterial Population Over a Time Period

Use the information from the graph and describe what happened to the bacteria over the entire time period.

Be sure to include:

- at least four population changes shown in the graph
- when each population change happened.

The population of the bacteria slowly began to increase at a steady rate until the 10th day when the population sharply increased from about 850 to about 3750 by the 14th day. After the 14th day the population stayed at about 3800 until the 17th day when the population dropped drasticly. Over a four day period the population decreased by 3,300 bacteria. After day 20 the rate of decrease became more gradual

05356

2008 Mathematics Sample Items

Annotated example for a 4-point response for question number 10:

The student shows understanding of extracting and explaining mathematical information from a graph by identifying the time period "*until the 10th day,*" identifying the population count "*250*" and describing the change in population "*slowly began to increase*" for the **Initial Growth** phase; identifying the time period "*the 10th day…by the 14th day,*" identifying the initial population "*250*" and the final population "*3750*" and describing the change in population "*sharply increased*" for the **Rapid Growth** phase; identifying the time period "*the 14th day…until the 17th day,*" identifying the population "*3800*" and identifying that the change in population remains constant "*stayed at about 3800*" for the **No Growth** phase; and identifying the time period "*17th day*" and indicating that the time period goes beyond day 17 "*Over a four day period,*" and identifying the initial population "*3800*" and final population "*decreased by 3,300*" and describing the change in population "*dropped drasticly*" for the **Decline** phase. This response earns four points.

10 Maria is observing bacterial growth in a science fair project. She put the bacteria in a petri dish and counted the number of bacteria. She then graphed the counts and drew a line to show the growth curve. The graph shows the population of the bacteria.

Bacterial Population Over a Time Period
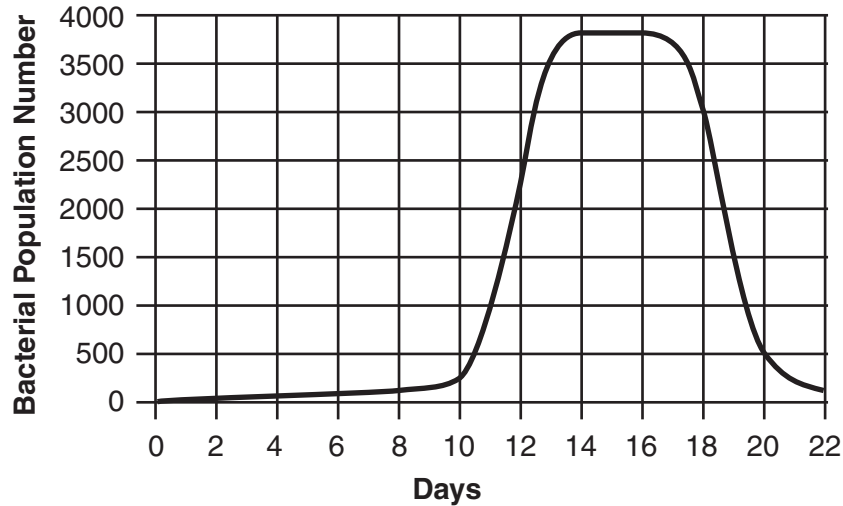
Use the information from the graph and describe what happened to the bacteria over the entire time period.

Be sure to include:

- at least four population changes shown in the graph
- when each population change happened.

10 days = 200 bacteria
Sudden change at 10 days
day 10 to 14 ≈ 3500 bacteria increase
day 13 to 17 = same at 3700
day 17 drop
days 17 to 20 = 3000 drop

Additional work space

day 21 = 200 bacteria

The bacteria was at a steady rise until day 10 when it shot up and came to it's peak at about day 14 and was steady till day 16 until it suddenly droped at about day 17 and came back down to it's normal at about day 20.

05356

2008 Mathematics Sample Items

Annotated example for a 4-point response for question number 10:

The student shows understanding of extracting and explaining mathematical information from a graph by identifying the time period "*until day 10*" and describing the change in population "*steady rise*" (by using the number 200 from the first page of the response, 'steady' is an acceptable descriptive for 'rise') for the **Initial Growth** phase; identifying the time period "*day 10 to 14*" and describing the change in population "*shot up*" for the **Rapid Growth** phase; identifying the time period "*day 14…till day 16*" and identifying that the change in population remains constant "*was steady*" for the **No Growth** phase; and identifying the time period "*about day 17*" and indicating that the time period goes beyond day 17 "*at about day 20,*" and describing the change in population "*suddenly droped*" for the **Decline** phase. This response earns four points.

10 Maria is observing bacterial growth in a science fair project. She put the bacteria in a petri dish and counted the number of bacteria. She then graphed the counts and drew a line to show the growth curve. The graph shows the population of the bacteria.

Bacterial Population Over a Time Period
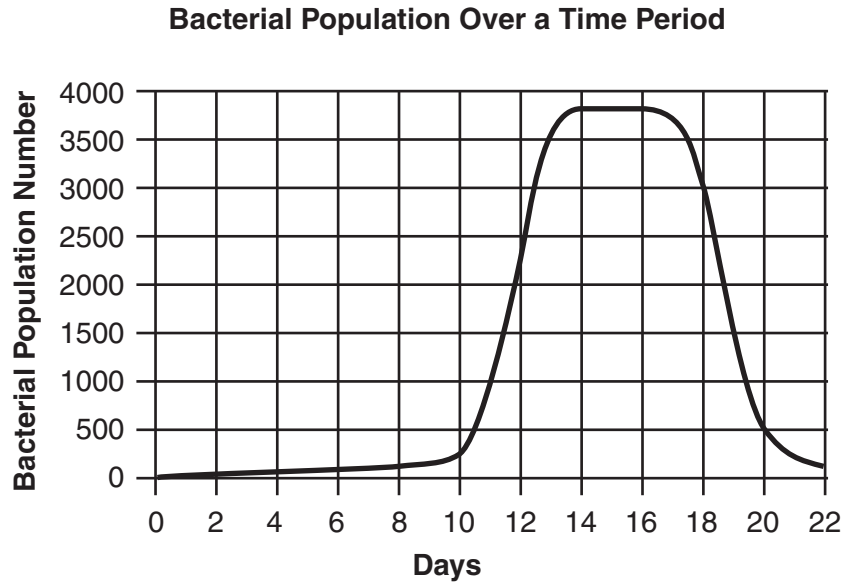
Use the information from the graph and describe what happened to the bacteria over the entire time period.

Be sure to include:

- at least four population changes shown in the graph
- when each population change happened.

from the day she started to the Tenth day the bacteria grew at a consistant Rate, but at the tenth day the bacteria shot up in numbers for about 3 days. It then didn't change for 3 the day, then dropped at 18th days. By the 22 day the bacteria population was where it was at on the tenth day.

Additional work space

05356

2008 Mathematics Sample Items

Annotated example for a 3-point response for question number 10:

The student shows partial understanding of extracting and explaining mathematical information from a graph by identifying the time period "*the tenth day…for about 3 days*" and describing the change in population "*shot up*" for the **Rapid Growth** phase; identify the time period "*for 3 days…16$^{1}/_{2}$ days*" and identifying that the change in population remains constant "*didn't change*" for the **No Growth** phase; and identifying the time period "*16$^{1}/_{2}$ days*" and indicating that the time period goes beyond day 16$^{1}/_{2}$ "*By the 22 day,*" and describing the change in population "*droped*" for the **Decline** phase. Although the student identifies the time period for the **Initial Growth** phase "*to the tenth day,*" they do not identify the population count and the description of the change in population "*grew at a consistant Rate*" is incomplete. The word "*consistant*" does not indicate how the population changed, i.e., grew consistently fast, grew consistently slow, etc. This response earns three points.

10 Maria is observing bacterial growth in a science fair project. She put the bacteria in a petri dish and counted the number of bacteria. She then graphed the counts and drew a line to show the growth curve. The graph shows the population of the bacteria.

Bacterial Population Over a Time Period
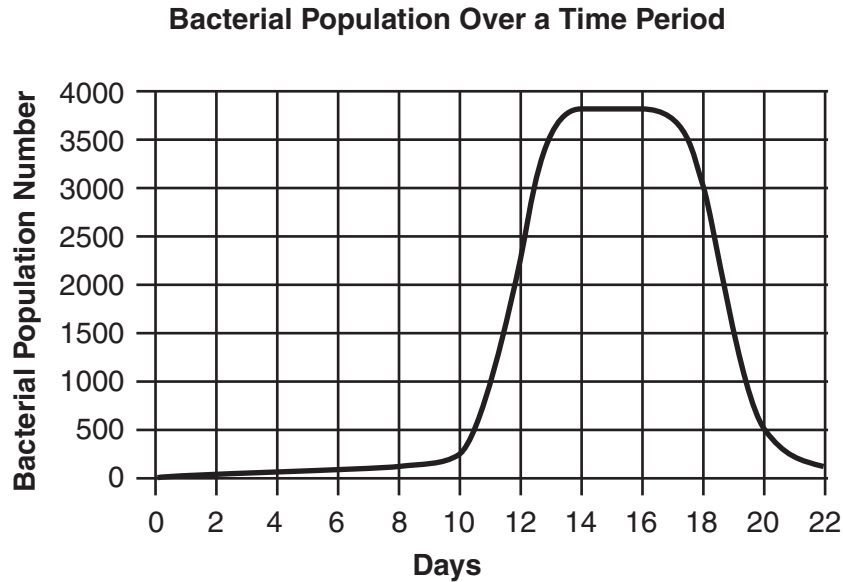
Use the information from the graph and describe what happened to the bacteria over the entire time period.

Be sure to include:

- at least four population changes shown in the graph
- when each population change happened.

Then was a steady climb in re bacteria population for the first 10 days. than from 10 days until about 13 days there was a dramatic climb from 250 to about 3 7500. Then the pop. leveled of then at 17 days the pop dramatically decreased from 3 7500 back down to about 250.

Additional work space

05356

2008 Mathematics Sample Items

Annotated example for a 3-point response for question number 10:

The student shows partial understanding of extracting and explaining mathematical information from a graph by identifying the time period "*the first 10 days,*" identifying the population count "*250*" and describing the change in population "*steady climb*" (this is an acceptable description since the word "*steady*" is qualified with the population count) for the **Initial Growth** phase; identifying the time period "*13 days…then at 17 days*" and identifying that the change in population remains constant "*leveled of*" for the **No Growth** phase; and identifying the time period "*then at 17 days,*" identifying the initial population and the final population "*37500 back down to about 250*" and describing the change in population "*dramatically decreaced*" for the **Decline** phase. Since credit was not given for "*37500*" in the **Rapid Growth** phase, the response is not penalized again for using the same number in the Decline phase. Although the student identifies the time period "*from 10 days untill about 13 days,*" describes the change in population "*dramatic climb,*" and identifies the initial population "*250,*" the final population "*37500*" is not within the acceptable interval for the Rapid Growth phase. This response earns three points.

10 Maria is observing bacterial growth in a science fair project. She put the bacteria in a petri dish and counted the number of bacteria. She then graphed the counts and drew a line to show the growth curve. The graph shows the population of the bacteria.

Bacterial Population Over a Time Period
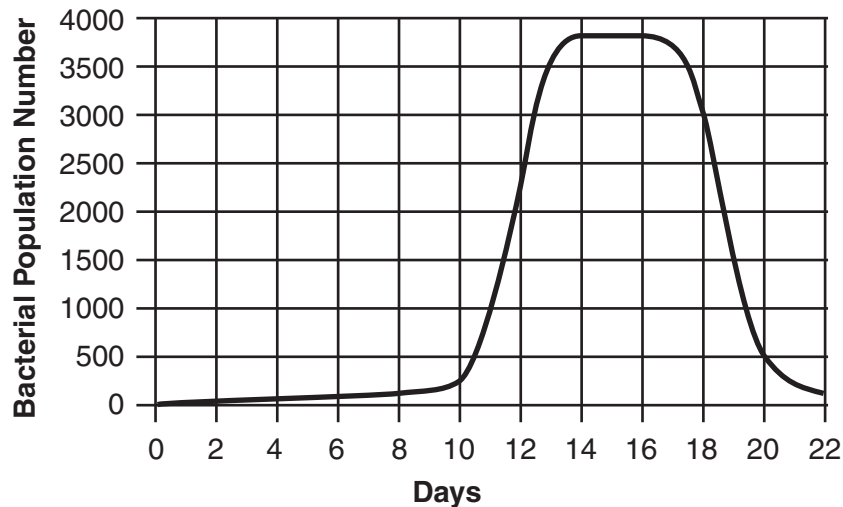
Use the information from the graph and describe what happened to the bacteria over the entire time period.

Be sure to include:

- at least four population changes shown in the graph
- when each population change happened.

FOR THE FIRST 10 DAYS, THE BACTERIA POPULATION STEADILY GREW TO ABOUT 250. AFTER DAY 10, THE BACTERIA STARTED GROWING VERY RAPIDLY TO ABOUT 3800 POPULATION IN JUST A 4 DAY PERIOD. ON ABOUT THE 18TH DAY, THE POPULATION BEGAN

Additional work space

RAPIDLY DECREASING BACK DOWN
TO ABOUT A 250 POPULATION
IN JUST 2 DAYS.

05356

2008 Mathematics Sample Items

Annotated example for a 2-point response for question number 10:

The student shows partial understanding of extracting and explaining mathematical information from a graph by identifying the time period *"FIRST 10 DAYS,"* identifying the population count *"250"* and describing the change in population *"StEADILY GREW"* (this is an acceptable description since the word *"STEADILY"* is qualified with the population count) for the **Initial Growth** phase; and identifying the time period *"AFTER DAY 10…IN JUST A 4 DAY PERIOD,"* identifying the initial population *"250"* and the final population *"3800,"* and describing the change in population *"STARTED GROWING VERY RAPIDLY"* for the **Rapid Growth** Phase. The No Growth phase is not addressed in the response. Although the initial and final population counts are given, along with a description of the change in population *"RAPIDLY DECREASING BACK DOWN,"* the time period for the Decline *"ON ABOUT THE 18TH DAY… IN JUST 2 DAYS"* phase is incorrect. This response earns two points.

10 Maria is observing bacterial growth in a science fair project. She put the bacteria in a petri dish and counted the number of bacteria. She then graphed the counts and drew a line to show the growth curve. The graph shows the population of the bacteria.
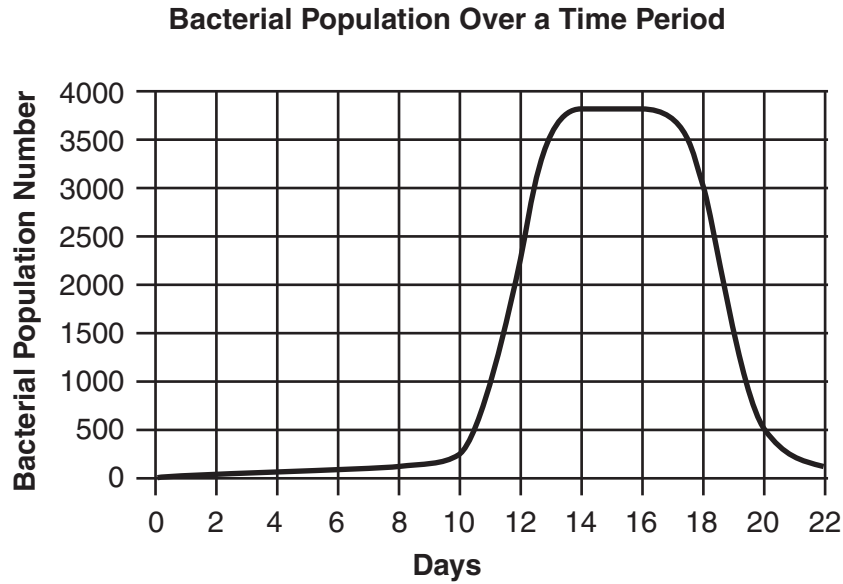
Bacterial Population Over a Time Period

Use the information from the graph and describe what happened to the bacteria over the entire time period.

Be sure to include:

- at least four population changes shown in the graph
- when each population change happened.

Additional work space

Maria first started her growing/observing of the bacteria on day 1. As day 2 came along there was already growth. As it went on to day 10, the bacteria growth grew at a steady pace, but sky-rocketed at day 11-13, then began to balance out for about 3-4 days. At about day 17 the bacteria growth stopped and had a down fall all the way to day 22.

05356

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2008 Mathematics Sample Items

Annotated example for a 2-point response for question number 10:

The student shows partial understanding of extracting and explaining mathematical information from a graph by identifying the time period "*then for about 3 – 4 days*" and identifying that the change in population remains constant "*began to balance out*" for the **No Growth** phase; and identifying the time period "*day 17*" and indicating that the time period goes beyond day 17 "*all the way to day 22*" and describing the change in population "*downfall*" for the **Decline** phase. Although the student identifies the time period "*to day 10*" for the **Initial Growth** phase, the description of the change in population "*grew at a steady pace*" is not acceptable because "*steady*" is not qualified with a population count; and although a description of the change in population "*sky-rocketed*" is given for the **Rapid Growth** phase, the time period is incorrect. This response earns two points.

10 Maria is observing bacterial growth in a science fair project. She put the bacteria in a petri dish and counted the number of bacteria. She then graphed the counts and drew a line to show the growth curve. The graph shows the population of the bacteria.
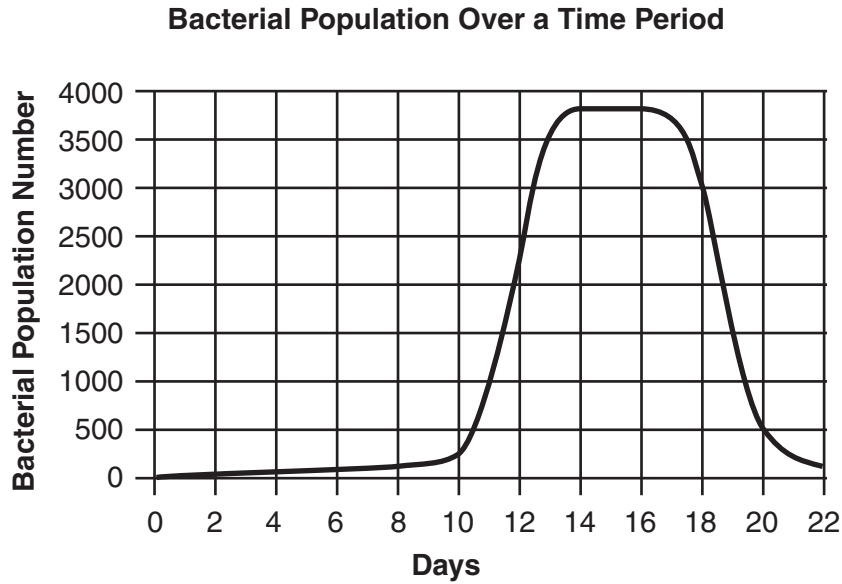
Bacterial Population Over a Time Period

Use the information from the graph and describe what happened to the bacteria over the entire time period.

Be sure to include:

- at least four population changes shown in the graph
- when each population change happened.

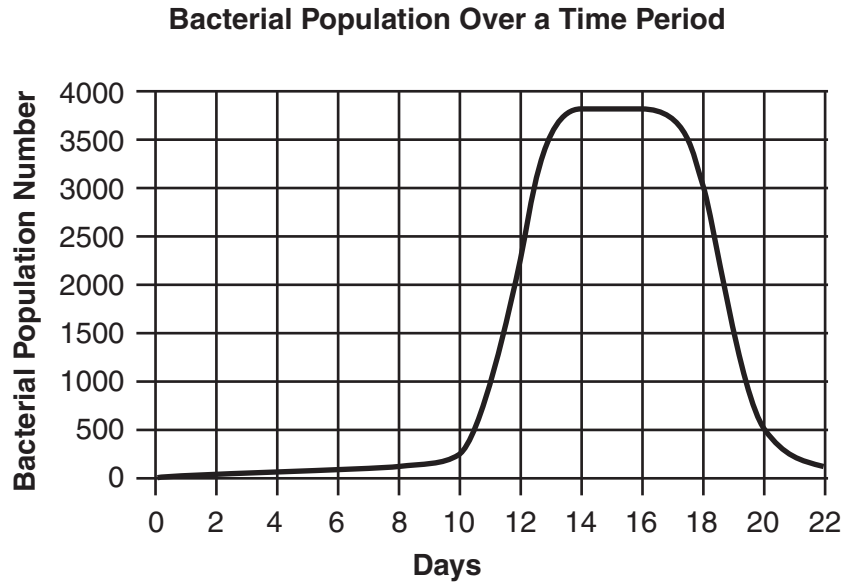| Bacterial populaton over a Time period	
Day	**Population**
2	0
4	50
6	100
8	160
10	250
12	2250
14	3500
16	3800
18	3000
20	500
22	200

05356

2008 Mathematics Sample Items

Annotated example for a 1-point response for question number 10:

The student shows partial understanding of extracting and explaining mathematical information from a graph by creating a table that includes at least 5 data points. This response earns one point.

10 Maria is observing bacterial growth in a science fair project. She put the bacteria in a petri dish and counted the number of bacteria. She then graphed the counts and drew a line to show the growth curve. The graph shows the population of the bacteria.

Bacterial Population Over a Time Period

Use the information from the graph and describe what happened to the bacteria over the entire time period.

Be sure to include:

- at least four population changes shown in the graph
- when each population change happened.

Additional work space

The bacteria grew slowly until day 10 then it grew quickly and dropped on day 20. The bacteria started dying.
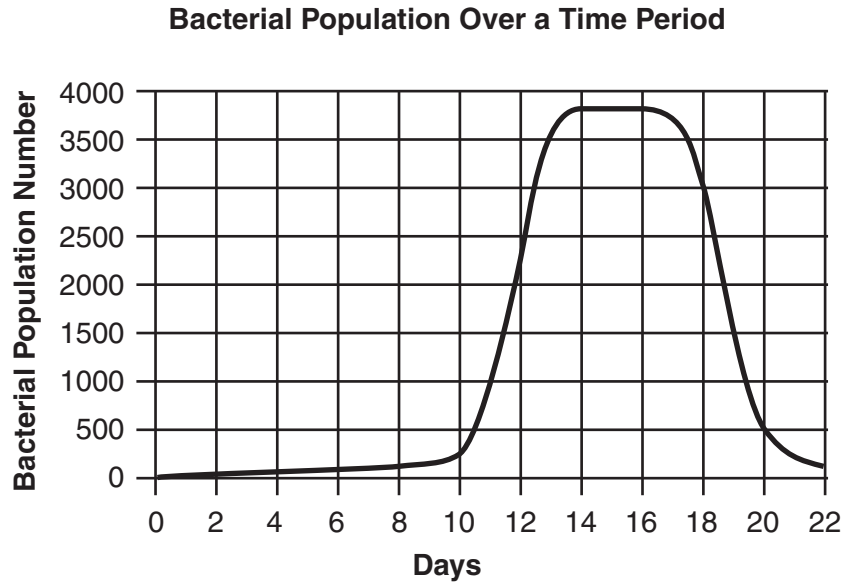
05356

2008 Mathematics Sample Items

Annotated example for a 1-point response for question number 10:

The student shows partial understanding of extracting and explaining mathematical information from a graph by identifying the time period "*until day 10*" and describing the change in population "*grew slowly*" for the **Initial Growth** phase. No information is given for the **Rapid Growth** phase, **No Growth** phase or **Decline** phase. This response earns one point.

10 Maria is observing bacterial growth in a science fair project. She put the bacteria in a petri dish and counted the number of bacteria. She then graphed the counts and drew a line to show the growth curve. The graph shows the population of the bacteria.

Bacterial Population Over a Time Period

Use the information from the graph and describe what happened to the bacteria over the entire time period.

Be sure to include:

- at least four population changes shown in the graph
- when each population change happened.

> It looks like it started slowly and than it increased more and more untill it almost hit 400 and than it whent back down.

Additional work space

05356

2008 Mathematics Sample Items

Annotated example for a 0-point response for question number 10:

The student shows little or no understanding of extracting and explaining mathematical information from a graph by only describing the change in population for the **Initial Growth** phase "*started slowly,*" the **Rapid Growth** phase "*increased more and more,*" and the Decline phase "*whent back down.*" The lack of the description of the change in population for the **No Growth** phase prevents this response from earning one point. This response earns zero points.