6th Grade Mathematics

Area and Surface Area
Unit 1 Pacing Calendar – Illustrative Mathematics

ORANGE PUBLIC SCHOOLS

OFFICE OF CURRICULUM AND INSTRUCTION

OFFICE OF MATHEMATICS

From the New Jersey Student Learning Standards:

In **Grade 6**, instructional time should focus on four critical areas: (1) connecting ratio and rate to whole number multiplication and division and using concepts of ratio and rate to solve problems; (2) completing understanding of division of fractions and extending the notion of number to the system of rational numbers, which includes negative numbers; (3) writing, interpreting, and using expressions and equations; and (4) developing understanding of statistical thinking.

(1) Students use reasoning about multiplication and division to solve ratio and rate problems about quantities. By viewing equivalent ratios and rates as deriving from, and extending, pairs of rows (or columns) in the multiplication table, and by analyzing simple drawings that indicate the relative size of quantities, students connect their understanding of multiplication and division with ratios and rates. Thus students expand the scope of problems for which they can use multiplication and division to solve problems, and they connect ratios and fractions. Students solve a wide variety of problems involving ratios and rates.

(2) Students use the meaning of fractions, the meanings of multiplication and division, and the relationship between multiplication and division to understand and explain why the procedures for dividing fractions make sense. Students use these operations to solve problems. Students extend their previous understandings of number and the ordering of numbers to the full system of rational numbers, which includes negative rational numbers, and in particular negative integers. They reason about the order and absolute value of rational numbers and about the location of points in all four quadrants of the coordinate plane.

(3) Students understand the use of variables in mathematical expressions. They write expressions and equations that correspond to given situations, evaluate expressions, and use expressions and formulas to solve problems. Students understand that expressions in different forms can be equivalent, and they use the properties of operations to rewrite expressions in equivalent forms. Students know that the solutions of an equation are the values of the variables that make the equation true. Students use properties of operations and the idea of maintaining the equality of both sides of an equation to solve simple one-step equations. Students construct and analyze tables, such as tables of quantities that are in equivalent ratios, and they use equations (such as $3x = y$) to describe relationships between quantities.

(4) Building on and reinforcing their understanding of number, students begin to develop their ability to think statistically. Students recognize that a data New Jersey Student Learning Standards for Mathematics 40 distribution may not have a definite center and that different ways to measure center yield different values. The median measures center in the sense that it is roughly the middle value. The mean measures center in the sense that it is the value that each data point would take on if the total of the data values were redistributed equally, and also in the sense that it is a balance point. Students recognize that a measure of variability (interquartile range or mean absolute deviation) can also be useful for summarizing data because two very different sets of data can have the same mean and median yet be distinguished by their variability. Students learn to describe and summarize numerical data sets, identifying clusters, peaks, gaps, and symmetry, considering the context in which the data were collected.

Yearlong Pacing Guide
Grade 6

Grade	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
5	Unit 1 5.NBT	Unit 2 5.NBT		Unit 3 5.NF		Unit 4 5.NF		Unit 5 5.MD	Unit 6 5.OA & 5.G	
6	Unit 1 6.G	Unit 2 6.RP	Unit 3 6.RP	Unit 4 6.NS		Unit 5 6.NS		Unit 6 6.EE	Unit 7 6.NS	Unit 8 6.SP
7	Unit 1 7.G	Unit 2 7.RP	Unit 3 7.G	Unit 4 7.RP	Unit 5 7.NS	Unit 6 7.EE		Unit 7 7.G		Unit 8 7.SP
8	Unit 1 8.G	Unit 2 8.G	Unit 3 8.EE	Unit 4 8.EE		Unit 5 8.F		Unit 6 8.SP	Unit 7 8.EE	Unit 8 8.G

Unit 1 — Geometry: Area and Surface Area

Unit 2 — Ratios & Proportional Relationships: Introducing Ratios

Unit 3 — Ratios & Proportional Relationships: Unit Rates & Percentages

Unit 4 — Number System: Dividing Fractions

Unit 5 — Number System: Arithmetic in Base Ten

Unit 6 — Expressions & Equations: Expressions & Equations

Unit 7 — Number System: Rational Numbers

Unit 8 — Statistics & Probability: Data Sets and Distributions

2019-2020 Grade 6 (iM)							
Quarter 1		**Quarter 2**		**Quarter 3**		**Quarter 4**	
Unit 1	Unit 2	Unit 3	Unit 4	Unit 5	Unit 6	Unit 7	Unit 8
6.G.1(S) 6.G.4(S)	6.RP.1(M) 6.RP.3a(M)	6.RP.2(M) 6.RP.3(M) 6.RP.3b(M) 6.RP.3c(M) 6.RP.3d(M)	6.NS.1(M) 6.G.2(S)	6.NS.3(A) 6.NS.2(A)	6.EE.6(M) 6.EE.5(M) 6.EE.7(M) 6.EE.4(M) 6.EE.2(M) 6.EE.3(M) 6.EE.1(M) 6.EE.9(M)	6.NS.5(M) 6.NS.6(M) 6.NS.7(M) 6.EE.8(M) 6.NS.8(M) 6.NS.4(A) 6.G.3(S)	6.SP.1(A) 6.SP.5(A) 6.SP.4(A) 6.SP.2(A) 6.SP.3(A)
22 Days	19 Days	19 Days	20 Days	18 Days	20 Days	20 Days	21 Days
Oct. 11	Nov. 15	Dec. 19	Jan. 31	Mar. 6	Apr. 9	May 19	Jun. 19

Major Work   Supporting Content   Additional Content

Table of Contents

I. Unit Overview

Grade 6 begins with a unit on reasoning about area and understanding and applying concepts of surface area. In grade 6, students extend their reasoning about area to include shapes that are not composed of rectangles. Doing this draws on abilities developed in earlier grades to compose and decompose shapes, for example, to see a rectangle as composed of two congruent right triangles. Students build on these abilities and their knowledge of areas of rectangles to find the areas of polygons by decomposing and rearranging them to make figures whose areas they can determine.

Students will learn strategies for finding areas of parallelograms and triangles, and develop formulas for these areas, using geometric properties to justify the correctness of these formulas. They use these formulas to solve problems. They understand that any polygon can be decomposed into triangles, and use this knowledge to find areas of polygons. Students will also find the surface areas of polyhedra with triangular and rectangular surfaces. They study, assemble, and draw nets for polyhedra and use nets to determine surface areas.

II. Pacing Guide

Activity	New Jersey State Learning Standards (NJSLS)	Estimated Time (Blocks)
Unit 1 Pre-Unit Diagnostic Assessment *Optional*	3.MD.C.7, 5.OA.A.2, 5.NF.B.4, 4.G.A.1, 4.G.A.2, 5.NBT.A.2	**1/2**
Lesson1: Tiling the Plane	6.G.A.1	1
Lesson 2: Finding Area by Decomposing & Rearranging	6.G.A.1	1
Lesson 3: Reasoning to Find Area	6.G.A.1	1
Lesson 4: Parallelograms	6.G.A.1	1
Lesson 5: Bases and Heights of Parallelograms	6.G.A.1, 6.EE.A.2a, 6.EE.A.2c	1
Lesson 6: Area of Parallelograms	6.G.A.1, 6.EE.A.2c	1
Lesson 7: From Parallelograms to Triangles	6.G.A.1	1
Lesson 8: Area of Triangles	6.G.A.1	1
Lesson 9: Formula for the Area of a Triangle	6.G.A.1, 6.EE.A.2a, 6.EE.A.2c	1
Lesson 10: Bases and Heights of Triangles	6.G.A.1, 6.EE.A.2c	1
Unit 1 Mid-Unit Assessment *Optional*	6.G.A.1, 6.EE.A.2a, 6.EE.A.2c	**1**
Lesson 11: Polygons	6.G.A.1	1
Lesson 12: What I Surface Area	6.G.A.4	1
Lesson 13: Polyhedra	6.G.A.4	1
Lesson 14: Nets and Surface Area	6.G.A.4	1
Lesson 15: More Nets, More Surface Area	6.G.A.2, 6.G.A.4	1
Lesson 16: Distinguishing Between Surface Area & Volume	6.G.A.4	1
Lesson 17: Squares & Cubes	6.EE.A, 6.EE.A.1	1
Lesson 18: Surface Area of a Cube	6.EE.A.1, 6.EE.A.2a, 6.G.A.4	1
Lesson 19: Designing a Tent	6.G.A.1, 6.G.A.4	1
Unit 1 End-of-Unit Assessment *Optional*	6.G.A.1, 6.G.A.4, 6.EE.A.1, 6.EE.A.2a, 6.EE.A.2c	**1**
Performance Task 1		**1/2**
Total Time		**22 Blocks**

Major Work Supporting Content Additional Content

III. Pacing Calendar

Please complete the pacing calendar based on the suggested pacing (*see Pacing Guide on page 1*).

SEPTEMBER

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

Please complete the pacing calendar based on the suggested pacing (*see Pacing Guide on page 1*).

OCTOBER

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

IV. PARCC Assessment Evidence Statements

Type I Type II Type III

NJSLS	Evidence Statement	Clarification	Math Practices	Calculator ?
6.G.1	Find the area of right triangles, other triangles, special quadrilaterals, and polygons by composing into rectangles or decomposing into triangles and other shapes; apply these techniques in the context of solving real-world and mathematical problems.	-	MP.1 MP.2 MP.5 MP.7	Yes
6.G.4	Represent three-dimensional figures using nets made up of rectangles and triangles, and use the nets to find the surface area of these figures. Apply these techniques in the context of solving real-world and mathematical problems.	-	MP.1 MP.4 MP.5	Yes
6.EE.1	Write numerical expressions involving whole-number exponents.	i) Tasks involve expressing b-fold products $a \cdot a \cdot \ldots \cdot a$ in the form ab, where a and b are non-zero whole numbers ii) Tasks do not require use of the laws of exponents	MP.8	No
6.EE.2a	Write, read, and evaluate expressions in which letters stand for numbers. a. Write expressions that record operations with numbers and with letters standing for numbers. For example, express the calculation "Subtract y from 5" as 5 – y.	i) Tasks do not have a context. ii) Numerical values in these expressions may include whole numbers, fractions, and decimals.	MP.8	Yes

6.EE.2c	Write, read, and evaluate expressions in which letters stand for numbers. c. Evaluate expressions at specific values of their variables. Perform arithmetic operations, including those involving whole-number exponents, in the conventional order when there are no parentheses to specify a particular order (Order of Operations).	i) Tasks do not have a context. ii) Numerical values in these expressions may include whole numbers, fractions, and decimals. iii) Task will not require operations on negative numbers.	MP.7	Yes
6.D.1	Solve multi-step contextual word problems with degree of difficulty appropriate to Grade 6, requiring application of knowledge and skills articulated in Type I, Sub-Claim A Evidence Statements.	i) Tasks may have scaffolding, if necessary, in order yield a degree of difficulty appropriate to Grade 6.	MP.1 MP.2 MP.4 MP.5 MP.7	Yes
6.D.2	Solve multi-step contextual problems with degree of difficulty appropriate to Grade 6, requiring application of knowledge and skills articulated in 5.NBT.B, 5.NF, 5.MD, and 5.G.A.	i) Tasks may have scaffolding, if necessary, in order yield a degree of difficulty appropriate to Grade 6.	MP.1 MP.2 MP.4 MP.5 MP.7	Yes

V. Differentiated Instruction

Supporting English Language Learners

There are four design principles for promoting mathematical language use and development in curriculum and instruction. The design principles and related routines work to make language development an integral part of planning and delivering instruction while guiding teachers to amplify the most important language that students are expected to bring to bear on the central mathematical ideas of each unit.

The design principles are:

Design Principle 1: Support sense-making
Design Principle 2: Optimize output
Design Principle 3: Cultivate conversation
Design Principle 4: Maximize linguistic and cognitive meta-awareness

These four principles are intended as guides for curriculum development and planning and execution of instruction, including the structure and organization of interactive opportunities for students, and the observation, analysis, and reflection on student language and learning. The design principles motivate the use of mathematical language routines (MLRs).

These eight routines are:

MLR1: Stronger and Clearer Each Time
MLR2: Collect and Display
MLR3: Critique, Correct, and Clarify
MLR4: Information Gap
MLR5: Co-Craft Questions and Problems
MLR6: Three Reads
MLR7: Compare and Connect
MLR8: Discussion Supports

Supporting Students with Disabilities

Lessons are designed to maximize access for all students, and include additional suggested supports to meet the varying needs of individual students. While the suggested supports are designed for students with disabilities, they are also appropriate for many children who struggle to access rigorous, grade-level content. Teachers should use their professional judgment about which supports to use and when, based on their knowledge of the individual needs of students in their classroom.

The inclusion of additional supports for students with disabilities offers additional strategies for teachers to meet the individual needs of a diverse group of learners. Lesson and activity-level supports for students with disabilities are aligned to an area of cognitive functioning and are paired with a suggested strategy aimed to increase access and eliminate barriers. These lesson specific supports help students succeed with a specific activity without reducing the mathematical demand of the task. All of the supports can be used discreetly and are designed to be used as needed.
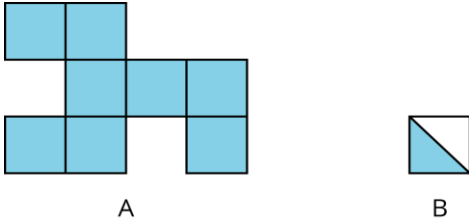
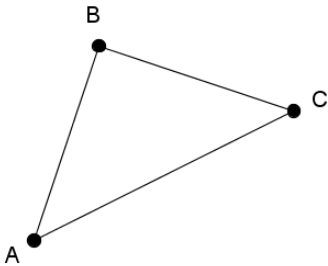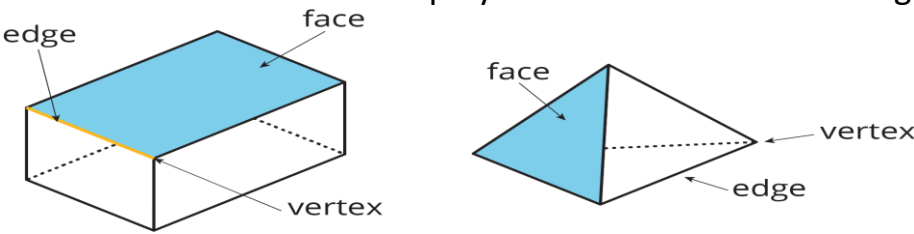Suggestions for supports fall under the following categories:

> Eliminate Barriers
> Processing Time
> Peer Tutors
> Assistive Technology
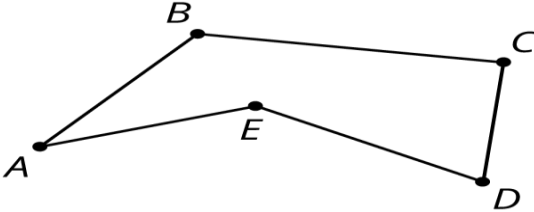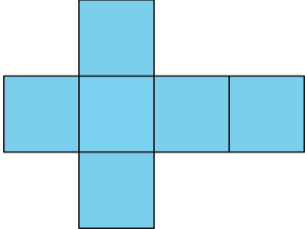> Visual Aids
> Graphic Organizers
> Brain Breaks

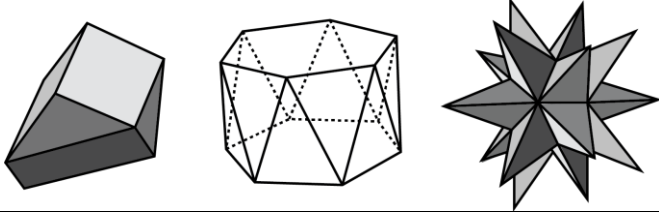For a more descriptive account of these supports, reference the following:

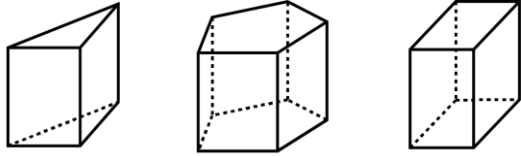https://im.openupresources.org/6/teachers/teacher_course_guide.html - supporting-students-with-disabilities

VI. VOCABULARY

Term	Definition
Area	The area of a two-dimensional region, measured in square units, is the number of unit squares that cover the region without gaps or overlaps. The side length of each square is 1 centimeter. The area of the shaded region A is 8 square centimeters. The area of shaded region B is 1/2 square centimeters.
Region	Examples of two-dimensional regions include the interior of a circle or the interior of a polygon. Here are two examples of two-dimensional regions. Area is a measure of two-dimensional regions. Examples of a three-dimensional region include the interior of a sphere or the interior of a cube.
Rearrange	When we decompose a figure into pieces and put them back together in a different way, we are rearranging the pieces.
Compose / Decompose	Compose means "put together" and decompose means "take apart." We use the word "compose" to describe putting several geometric figures together to make a new figure.
Parallelogram	A parallelogram is a four-sided polygon with two pairs of parallel sides.

Base/Height of a Parallelogram	Any of the four sides of a parallelogram can be chosen as a base. The term *base* can also refer to the length of this side. Once we have chosen a base, then a perpendicular segment from a point on the base of a parallelogram to the opposite side will always have the same length. We call that value the height.
Opposite Vertex	When you choose a side to be the base in a triangle, the vertex that is not an endpoint of the base is the opposite vertex. Point A is the opposite vertex to the base BC.
Base/Height of a Triangle	Any of the three sides of a triangle can be chosen as a base. The term *base* can also refer to the length of this side. Once we have chosen a base, the corresponding height is the length of a perpendicular segment from the base to the vertex opposite it. The opposite vertex is the vertex that is not an endpoint of the base.
Quadrilateral	A quadrilateral is a four-sided polygon.
Vertex (vertices)	A vertex is a point where two edges meet in a polygon or a polyhedron.
Edge	A line segment in a polygon is called an edge (it is also called a side). A line segment where two faces meet in a polyhedron is also called an edge.

Side	A line segment in a polygon is called a side (it is also called an edge). Sometimes the faces of a polyhedron are called its sides.
Polygon	A polygon is a two-dimensional figure composed of a sequence of straight line segments, connected end-to-end, with the last one connecting back to the first. We call the line segments the edges or sides of the polygon. We call a point where the edges connect a vertex. The edges of a polygon never cross each other. The plural of vertex is vertices. A polygon always encloses a two-dimensional region. Here is a polygon with five vertices A, B, C, D, and E and five edges (or sides): AB, BC, CD, DE, and EA. ![polygon with vertices A, B, C, D, E]
Surface Area	The surface area (in square units) is the number of unit squares it takes to cover all the surfaces of a three-dimensional figure without gaps or overlaps.
Face	Any flat surface on a three-dimensional figure is a face.
Net	A net is a two-dimensional representation of a polyhedron. It can be cut out and folded to make a model of the polyhedron. Here is a net for a cube. ![net for a cube]

Polyhedron (Polyhedra)	A polyhedron is a three-dimensional figure with faces that are polygonal regions (filled-in polygons). Each face meets one and only one other face along a complete edge. The points where edges meet are called vertices. The plural of polyhedron is polyhedra. A polyhedron always encloses a three-dimensional region. Here are some drawings of polyhedra.
Prism	A prism is a type of polyhedron with two parallel faces that are identical copies of each other (called bases) connected by rectangles. A prism is named for the shape of its bases; for example, if its base is a pentagon, then it is called a "pentagonal prism." Here are some drawings of some prisms. triangular prism pentagonal prism rectangular prism
Pyramid	A pyramid is a type of polyhedron that has one special face called the base. All of the other faces are triangles that all meet at a single vertex. A pyramid is named for the shape of its base; for example, if its base is a pentagon, then it is called a "pentagonal pyramid."
Square of a Number / Squaring a Number	An expression with an exponent of 2 is sometimes called a square. The reason s2 is called the square of s is that a square whose edge has length s has area s2.
Cube of a Number / Cubing a Number	An expression with an exponent of 3 is sometimes called a cube. The reason s3 is called the cube of s is that a cube whose edge has length s has volume s3.
Exponent	When we write an expression like 7n, we call n the exponent.

VII. Assessment Framework

| Unit 1 Assessment Framework				
Assessment	**NJSLS**	**Estimated Time**	**Format**	**Graded ?**
Pre-Unit Diagnostic Assessment (Beginning of Unit – Optional) *Illustrative Mathematics*	6.G.A.1, 6.G.A.4, 6.EE.A.1, 6.EE.A.2a, 6.EE.A.2c	½ Block	Individual	Yes (No Weight)
Mid-Unit Assessment (After Lesson 10-Optional) *Illustrative Mathematics*	6.G.A.1, 6.EE.A.2a, 6.EE.A.2c	1 Block	Individual	Yes
End-of-Unit Assessment (End of Unit – Optional) *Illustrative Mathematics*	6.G.A.1, 6.G.A.4, 6.EE.A.1, 6.EE.A.2a, 6.EE.A.2c	1 Block	Individual	Yes

Unit 1 Performance Assessment Framework				
Assessment	**NJSLS**	**Estimated Time**	**Format**	**Graded ?**
Unit 1 Performance Task 1 (Early October) *Areas of Right Triangles*	6.G.A.1	½ Block	Individual w/ Interview Opportunity	Yes; Rubric
Unit 1 Performance Task Option 1 (Optional) *Nets, Pyramids and Prisms*	6.G.A.4	Teacher Discretion	Teacher Discretion	Yes, if administered

Name _____ Block _____ Date _____

Areas of Right Triangles (NJSLS 6.G.A.1)

A. Explain why the right triangle shown has an area of exactly 20 square units.
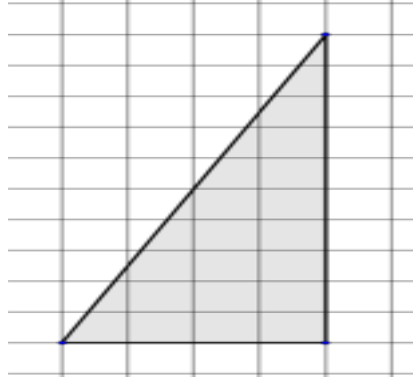
B. The "legs" of a right triangle are the two sides that form the right angle. If one leg of a right triangle is 5 units long, explain what else would have to be true about the right triangle in order for its area to be 30 square units.

C. Here are leg measurements for more right triangles. What is the area of each?

   i.   6 and 3

   ii.   12 and 4 1/2

   iii.   3 and 7

   iv.   6.5 and 9

D. Explain in words how you can find the area of a right triangle when you know the lengths of its legs.

E.   Let *a* represent the length of one leg of a right triangle and *b* represent the length of the other leg of the right triangle. Write a mathematical expression for the area of the right triangle in terms of *a* and *b*.

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Unit 1 Performance Task 1 PLD Rubric

SOLUTION

A. Completing the rectangle with sides of length 4 and 10 and arguing that half of its area must be 20 square units.

B. The other leg would have to measure 12 units in length.

C. i) 9   ii) 27   iii) 21/2 or 10 ½ or 10.5   iv) 29.25 or 117/4

D. Answers may vary. Examples: Multiply the lengths of the legs together, and then divide by 2. One half of the product of the lengths of the legs.

E. ab/2, 1/2ab , a✕b÷2 , or equivalent

Level 5: Distinguished Command	Level 4: Strong Command	Level 3: Moderate Command	Level 2: Partial Command	Level 1: No Command
All parts are correct. Clearly constructs and communicates a complete response based on concrete referents provided in the prompt or constructed by the student such as diagrams that are connected to a written (symbolic) method, number line diagrams or coordinate plane diagrams, including: • a logical approach based on a conjecture and/or stated assumptions • a logical and complete progression of steps • complete justification of a conclusion with minor computational error	4 parts are correct. Clearly constructs and communicates a complete response based on concrete referents provided in the prompt or constructed by the student such as diagrams that are connected to a written (symbolic) method, number line diagrams or coordinate plane diagrams, including: • a logical approach based on a conjecture and/or stated assumptions • a logical and complete progression of steps • complete justification of a conclusion with minor conceptual error	3 parts are correct. Clearly constructs and communicates a complete response based on concrete referents provided in the prompt or constructed by the student such as diagrams that are connected to a written (symbolic) method, number line diagrams or coordinate plane diagrams, including: • a logical, but incomplete, progression of steps • minor calculation errors • partial justification of a conclusion • a logical, but incomplete, progression of steps	2 parts are correct. Constructs and communicates an incomplete response based on concrete referents provided in the prompt such as: diagrams, number line diagrams or coordinate plane diagrams, which may include: • a faulty approach based on a conjecture and/or stated assumptions • An illogical and Incomplete progression of steps • majr calculation errors • partial justification of a conclusion	1 part correct or no parts are correct. The student shows no work or justification.

Name _____   Block _____   Date _____

Nets, Pyramids and Prisms (NJSLS 6.G.A.4)

Task

a.   Below is a net for a three dimensional shape:
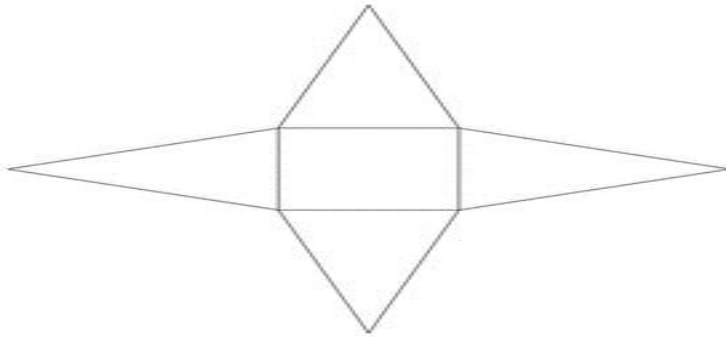
The inner quadrilateral is a square and the four triangles all have the same size and shape.

i.   What three dimensional shape does this net make? Explain.

ii.   If the side length of the square is 2 units and the height of the triangles is 3 units, what is

      the surface area of this shape?

b.   Draw a net for a rectangular prism whose base is a one inch by one inch square and whose

faces are 3 inches by 1 inch.

i.   Is there more than one possible net for this shape? Explain.

ii.   What is the surface area of the prism?

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IX. 21st Century Career Ready Practices

CRP1. Act as a responsible and contributing citizen and employee.
CRP2. Apply appropriate academic and technical skills.
CRP3. Attend to personal health and financial well-being.
CRP4. Communicate clearly and effectively and with reason.
CRP5. Consider the environmental, social and economic impacts of decisions.
CRP6. Demonstrate creativity and innovation.
CRP7. Employ valid and reliable research strategies.
CRP8. Utilize critical thinking to make sense of problems and persevere in solving them.
CRP9. Model integrity, ethical leadership and effective management.
CRP10. Plan education and career paths aligned to personal goals.
CRP11. Use technology to enhance productivity.
CRP12. Work productively in teams while using cultural global competence.

For additional details see **21st Century Career Ready Practices** .

References

"Illustrative Mathematics" *Open Up Resources.* 2018

        <https://auth.openupresources.org/register/complete>