Common Core Mathematics Challenge

Level: Grade Five

Domain: Geometry

Cluster: Graph points on the coordinate plane to solve real-world and mathematical problems.

Standard

Represent real world and mathematical problems by graphing points in the first quadrant of the coordinate plane, and interpret coordinate values of points in the context of the situation.

Common Core Mathematics Challenge

Geometry
Grade 5–Planning Coordinate City

The purpose of the Mathematics Challenges is to provide opportunities for students to develop and demonstrate understanding of important mathematical concepts and standards. Each Challenge includes a set of tasks that require higher-order thinking skills. Because these types of tasks may be new for students and they will have varying levels of understanding, the student responses will vary. The Challenges and guiding questions were designed to help teachers plan their implementation and elicit, analyze, and act on evidence of student understanding.

Each packet contains all the materials necessary to implement the Mathematics Challenge including a grade-appropriate Challenge, the Mathematics Challenge Meeting Protocol, and the Guiding Questions for Analyzing Student Responses to Mathematics Challenges.

For each Challenge, you will complete a six step process of planning, implementation, and analysis and reflection.

The Mathematics Challenge Process

Stage	Step	Task
Planning	Step 1.	Review the Mathematics Challenge Meeting Protocol
	Step 2.	Review and solve the Mathematics Challenge prior to your Professional Learning Community meeting. Think about your responses to the guiding questions on the Meeting Protocol
	Step 3.	Hold your Professional Learning Community meeting and discuss your responses to the Guiding Questions on the Meeting Protocol
Implementation	Step 4.	Implement the Mathematics Challenge with your class
Analysis and Reflection	Step 5.	For your own planning and documentation, respond to the Guiding Questions on the Analyzing Student Responses Protocol
	Step 6.	To help us improve the Challenges and to provide recommendations for teachers implementing them in future years, complete the Mathematics Challenge Feedback Log and provide copies of all student work to the Assessment Coordinator

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Mathematics Challenge Meeting Protocol

Your Professional Learning Community will meet to discuss the implementation of one Mathematics Challenge. In preparation for your meeting, please print and review the Mathematics Challenge, solve all tasks within the Challenge, and think about the guiding questions below. These questions will be used to facilitate a group discussion regarding the implementation of the upcoming Mathematics Challenge.

Guiding Questions for Implementing the Mathematics Challenges

1. What is the title of the Challenge that you will use?
2. What skills or standards is this Challenge measuring?
3. Where does this Challenge fit within your curriculum? Within which unit?
4. At what point during the unit will you administer this Challenge (e.g., At the beginning of a unit to determine what students do or do not know, at the end of a unit to assess what students have or have not learned, in the middle of a unit to determine where to go next instructionally)?
5. How will your students complete this Challenge (e.g., individually, one-on-one, in small groups, as a class)? Why?
6. Are there any prerequisite skills, common misunderstandings, or vocabulary needs that you will have to address? What are they?
7. What difficulties do you anticipate your students will have with the Challenge? How will you address them?
8. Are these skills and difficulties different for special needs students, ELL students, etc.? How? Will you do anything different for these students? What?
9. How will you evaluate student responses (e.g., grade responses with the provided rubric, scan responses to identify common mistakes/misconceptions, have students evaluate one another's responses, have students evaluate their own response)?
10. What will student responses to this Challenge tell you about student understanding?
11. How might you use this evidence of student understanding to adapt your teaching and learning?
12. What other materials, resources, or support might you need? Where can you get them?
13. How can your colleagues assist you in the analysis of student understanding?
14. What other questions or concerns do you have about this Mathematics Challenge?

After you have implemented the challenge with your class, be sure to respond to the Guiding Questions on the Analyzing Student Responses Protocol.

Common Core Mathematics Challenge

Geometry
Grade 5–Planning Coordinate City

Domain: Geometry

Cluster: Graph points on the coordinate plane to solve real-world and mathematical problems.

Standard:
Represent real world and mathematical problems by graphing points in the first quadrant of the coordinate plane, and interpret coordinate values of points in the context of the situation.

Task Preparation:
Each student will need a copy of the Student Response Sheet, a pencil, crayons, and possibly rulers (for drawing straight lines).

Stimulus Cards (Drawing or Word Description):
None

Manipulatives/Supplies:
Pencils, crayons, and possibly rulers (for drawing straight lines)

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Geometry

Grade 5–Planning Coordinate City

Cues/Directions:

Distribute student response sheets. Students should be directed to look carefully at each figure. Allow students time to answer.

1. Instruct students to follow along as you read aloud and say: **The grid below shows the outlines of some buildings planned for Coordinate City. (TEACHER NOTE:** Have students look at the shapes on the grid. You may want to give students the opportunity to make observations about what they see.**)**

   a. Put the letter P inside each building with an outline shape that is a polygon. (TEACHER NOTE: Students should write the letter P inside each shape that is a polygon.**) How do you know the shapes you marked with a P are polygons and the other shapes are not polygons? (TEACHER NOTE:** Students should write their explanations in the box.**)**

   b. The sides of some buildings are parallel to the sides of other buildings. Write all the sides that are parallel to side XY. (TEACHER NOTE: Students should write the pairs of letters for the three sides parallel to XY on the blanks provided.**) How can you tell? (TEACHER NOTE:** Students should write their explanations in the box.**)**

   c. Name 2 sides of buildings that are perpendicular to each other. (TEACHER NOTE: Students should write the pairs of letters for 2 perpendicular sides on the blanks provided.**)**

   d. What are the coordinates of the point T? (TEACHER NOTE: Students should write the coordinates of the point T on the blanks provided.**) Give the letter names of 3 points that have the same <u>first</u> coordinate as T. (TEACHER NOTE:** Students should write the letters for the three points on the blanks provided.**) Give the letter names of 3 points that have the same <u>second</u> coordinate as T. (TEACHER NOTE:** Students should write the letters for the three points on the blanks provided.**)**

2. **Shawna is helping to design buildings on the slide grid of the city. The shape of a building is on the grid below. It is called triangle ABC. (TEACHER NOTE:** Have students look at the grid. You may want to give students the opportunity to make observations about what they see.**)** **Name the coordinates of points A, B, and C. (TEACHER NOTE:** Students should write the coordinates of each point on the blanks provided.**)**

   a. On the slide grid, you slide a shape to a new position to design a new building. There are 2 slides allowed on the grid. Slide 1 must be right or left. Slide 2 must be up or down. Shawna decides to slide triangle ABC using the following slides. Slide 1. Go right 2 numbers. Slide 2. Go up 5 numbers. Follow Shawna's slides and draw the new triangle in the slide grid. Label the new triangle EFG. (TEACHER NOTE: Students should follow the directions to slide the triangle and label the new triangle EFG.**) How do you know you put the new triangle in the correct place? (TEACHER NOTE:** Students should write their explanations in the box.**)**

   b. Put one more triangle on the slide grid. (You can put it anywhere on the grid.) Call the new triangle JKL. (TEACHER NOTE: Students should plot a third triangle on the grid which is congruent to the other two triangles and label the new triangle JKL.**) Using 2 slides, how can you slide triangle EFG to get to triangle JKL? (TEACHER NOTE:** Students should write their explanations in the box.**)**

   c. Look at the slide grid. (TEACHER NOTE: Students should look at their grids.**) Using 2 slides, how can you slide triangle JKL to get back to triangle ABC? (TEACHER NOTE:** Students should write their explanations in the box.**)**

3. **Malcolm is helping to design buildings on the flip grid of the city. The shape of a building is on the grid below. It is called triangle RST. (TEACHER NOTE:** Have students look at the grid. You may want to give students the opportunity to make observations about what they see.**)** **Name the coordinates of points R, S, and T. (TEACHER NOTE:** Students should write the coordinates of each point on the blanks provided.**)**

   a. On the flip grid, you flip a shape to design a new building. There are 2 flips allowed on the grid. You can flip over a horizontal line. You can flip over a vertical line. Malcolm decides to flip triangle RST using the following flip. Flip over the horizontal line at 5. Find the dashed horizontal line at 5 on the flip grid. Follow Malcolm's flip and draw the new triangle. Label the new triangle UVW. (TEACHER NOTE: Students should follow the directions to flip the triangle and label the new triangle UVW.**) How do you know you put triangle UVW in the correct place? (TEACHER NOTE:** Students should write their explanations in the box.**)**

   b. Malcolm plans another new building. He decides to flip triangle RST over the <u>vertical</u> line at 5. Find the dotted vertical line at 5 on the flip grid. Follow Malcolm's flip and draw the new triangle. Label the new triangle XYZ. (TEACHER NOTE: Students should follow the directions to flip triangle RST and label the new triangle JKL.**) How do you know you put triangle XYZ in the correct place? (TEACHER NOTE:** Students should write their explanations in the box.**)**

4. **(TEACHER NOTE:** This task may be a stretch for some students. If you feel it is beyond the scope of your class, you may omit it, use it as enrichment, or use it as a whole-class or small-group activity.**)**

   Which grid do you like better to work on? The slide grid or the flip grid? Explain why. (TEACHER NOTE: Students should write their explanations in the box.**)**

Common Core Mathematics Challenge

Geometry

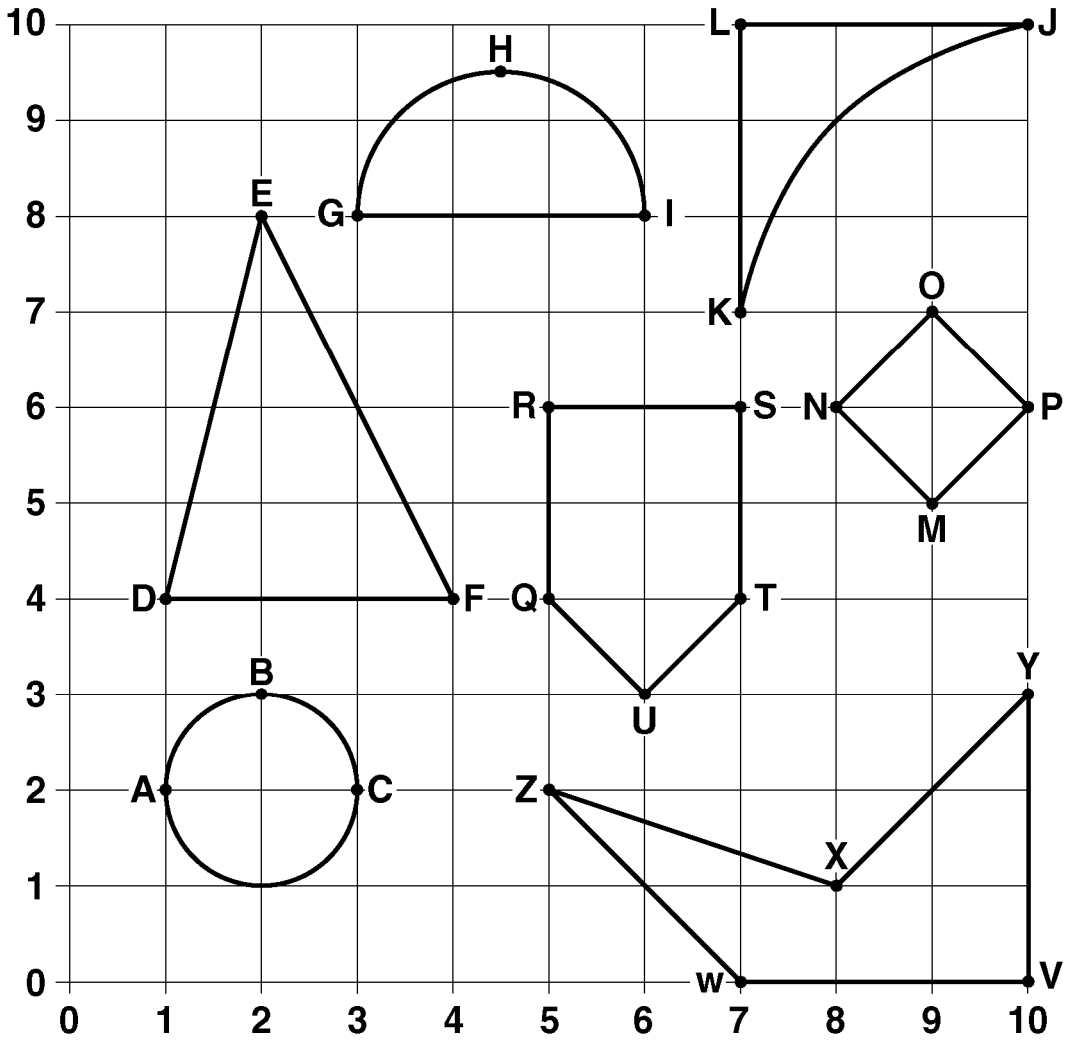
Grade 5–Planning Coordinate City

Student Response Sheet

Planning Coordinate City

Name: _____ **Date:** _____

1. The grid below shows the outlines of some buildings planned for Coordinate City.



a. Put the letter P inside each building with an outline shape that is a polygon.

How do you know the shapes you marked with a P are polygons and the other shapes are not polygons?

b. The sides of some buildings are parallel to the sides of other buildings. Write all the sides that are parallel to side XY.

_____ _____ _____

How can you tell?

c. Name 2 sides of buildings that are perpendicular to each other.

_____ **and** _____

d. What are the coordinates of the point T?

(_____ , _____)

Give the letter names of 3 points that have the same <u>first</u> coordinate as T.

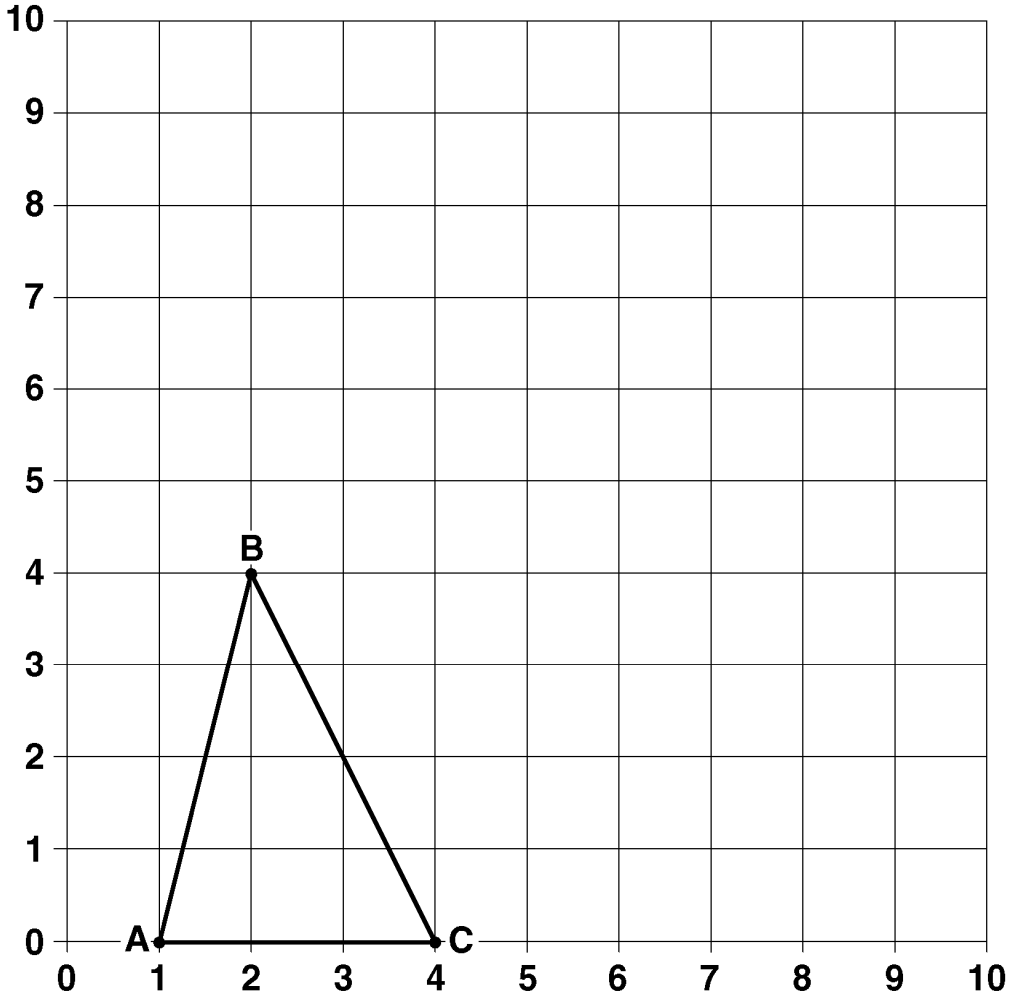
_____ _____ _____

Give the letter names of 3 points that have the same <u>second</u> coordinate as T.

_____ _____ _____

2. Shawna is helping to design buildings on the slide grid of the city. The shape of a building is on the grid below. It is called triangle ABC.

SLIDE GRID



Name the coordinates of points A, B, and C.

Point A: (_____ , _____)

Point B: (_____ , _____)

Point C: (_____ , _____)

a. On the slide grid, you slide a shape to a new position to design a new building. There are 2 slides allowed on the grid.

- **Slide 1 must be right or left.**
- **Slide 2 must be up or down.**

Shawna decides to slide triangle ABC using the following slides.

- **Slide 1. Go right 2 numbers.**
- **Slide 2. Go up 5 numbers.**

Follow Shawna's slides and draw the new triangle in the slide grid. Label the new triangle EFG.

How do you know you put the new triangle in the correct place?

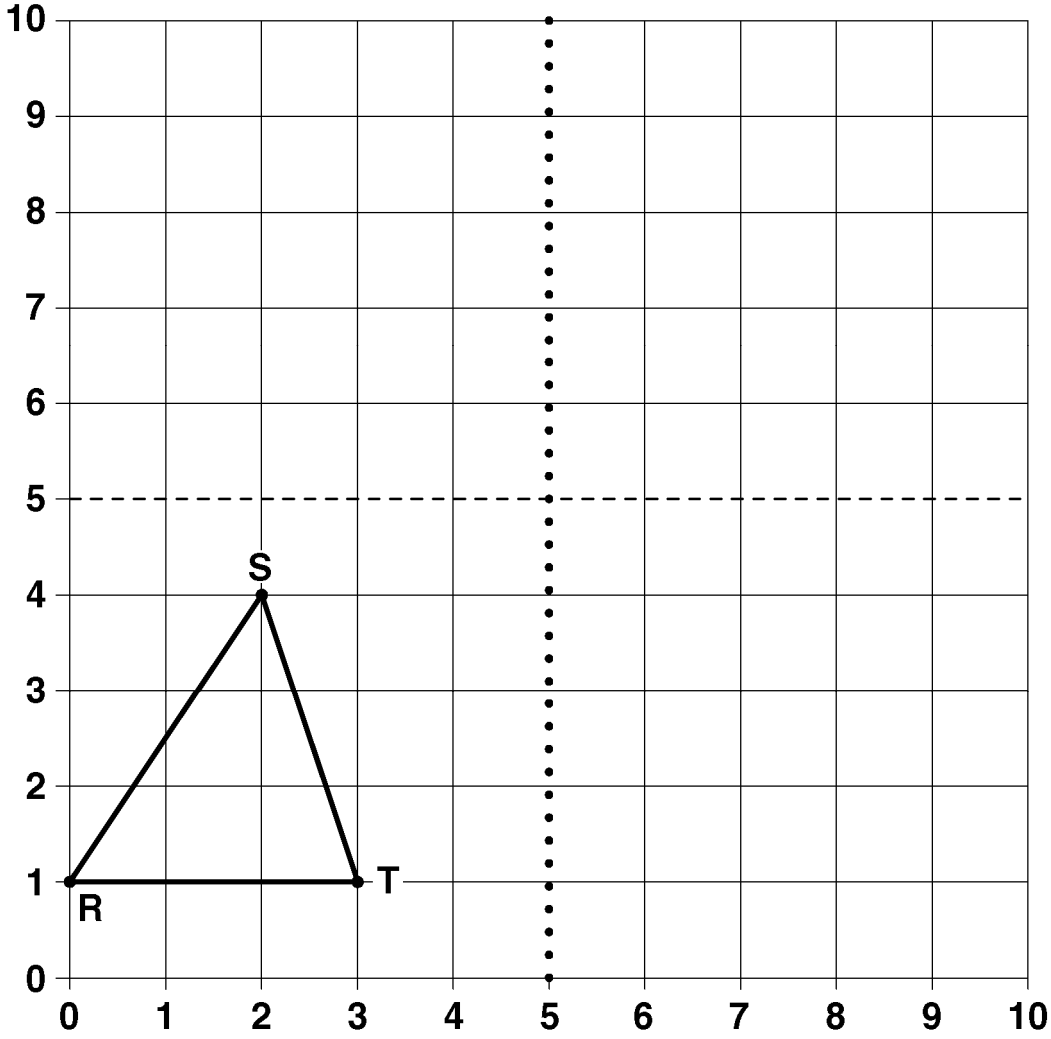
b. Put one more triangle on the slide grid. (You can put it anywhere on the grid.) Call the new triangle JKL.

Using 2 slides, how can you slide triangle EFG to get to triangle JKL ?

c. Look at the slide grid. Using 2 slides, how can you slide triangle JKL to get back to triangle ABC ?

3. Malcolm is helping to design buildings on the flip grid of the city. The shape of a building is on the grid below. It is called triangle RST.

FLIP GRID



Name the coordinates of points R, S, and T.

Point R: (_____ , _____)

Point S: (_____ , _____)

Point T: (_____ , _____)

a. On the flip grid, you flip a shape to design a new building. There are 2 flips allowed on the grid.

- **You can flip over a horizontal line.**
- **You can flip over a vertical line.**

Malcolm decides to flip triangle RST using the following flip.

- **Flip over the horizontal line at 5.**

Find the dashed horizontal line at 5 on the flip grid. Follow Malcolm's flip and draw the new triangle. Label the new triangle UVW.

When the triangle is flipped, point R will be at a new point. What are the coordinates of the new point?

(_____ , _____)

How do you know you put triangle UVW in the correct place?

b. Malcolm plans another new building. He decides to flip triangle RST over the <u>vertical</u> line at 5.

Find the dotted vertical line at 5 on the flip grid. Follow Malcolm's flip and draw the new triangle. Label the new triangle XYZ.

How do you know you put triangle XYZ in the correct place?

4. Which grid do you like better to work on? The slide grid or the flip grid? Explain why.

Geometry
Grade 5–Planning Coordinate City

Learning and Teaching Considerations

Task 1:

A) Be sure that students understand that polygons are simple closed curves with all straight sides.

B) If a student says or writes, "I just know", prompt him or her by saying something like "I'm glad you know, but it's important in math to be able to explain your answers so other people can understand what you're thinking."

C) If a student says or writes, "I don't know," say something positive like "Let's start with what you do know about this problem." Students often know more than they think or say, and encouraging them to vocalize or write about that knowledge is all they need.

D) Students may have the misconception that shapes that do not close are polygons (as long as they have straight sides)

E) Students may have the misconception that a not simple closed curve can be a polygon (the sides can cross).

F) Be sure that students are able to identify parallel and perpendicular line segments

G) Be sure that students are able to use a grid system to identify location

H) Students may use pencil markings on the grid to identify parallel and perpendicular line segments, determine coordinates of point T and/or vertical and horizontal directions from point T.

Task 2:

A) Be sure that students are able to understand that shapes can be described in terms of their location in a plane or in space. Coordinate systems can be used to describe these locations precisely.

B) Be sure that students understand that the coordinate view of shape offers another way to understand certain properties of shapes and changes in positions (transformations).

C) Students may use the vertices to describe movement in the grid, either by referring to the movement of each point by name, or by referring to the coordinates of each point..

D) Be sure that students are able to correctly describe two slides based on the locations of the triangles.

E) Students may have the misconception that the coordinates of the points are reversed (slides up or down giving them the first coordinate).

F) Students may have the misconception that they can change the size or shape in their slides (or translations).

G) Teachers can encourage students to cut out shapes and slide them, then trace them where they land.

Task 3:

A) Be sure that students understand the reflection process or flip.

B) Students may use grid markings to indicate flipping vertices over the horizontal or vertical line.

C) Students may count the horizontal or vertical distance from the line to convince themselves that the triangle is in the correct place.

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D) Teachers can encourage students to cut out shapes and flip them over the horizontal or vertical line, then trace them where they land.

E) Students may have the misconception that the horizontal line is the vertical line or visa versa.

F) Students may have the misconception that they can change the size or shape in their flips (or reflections).

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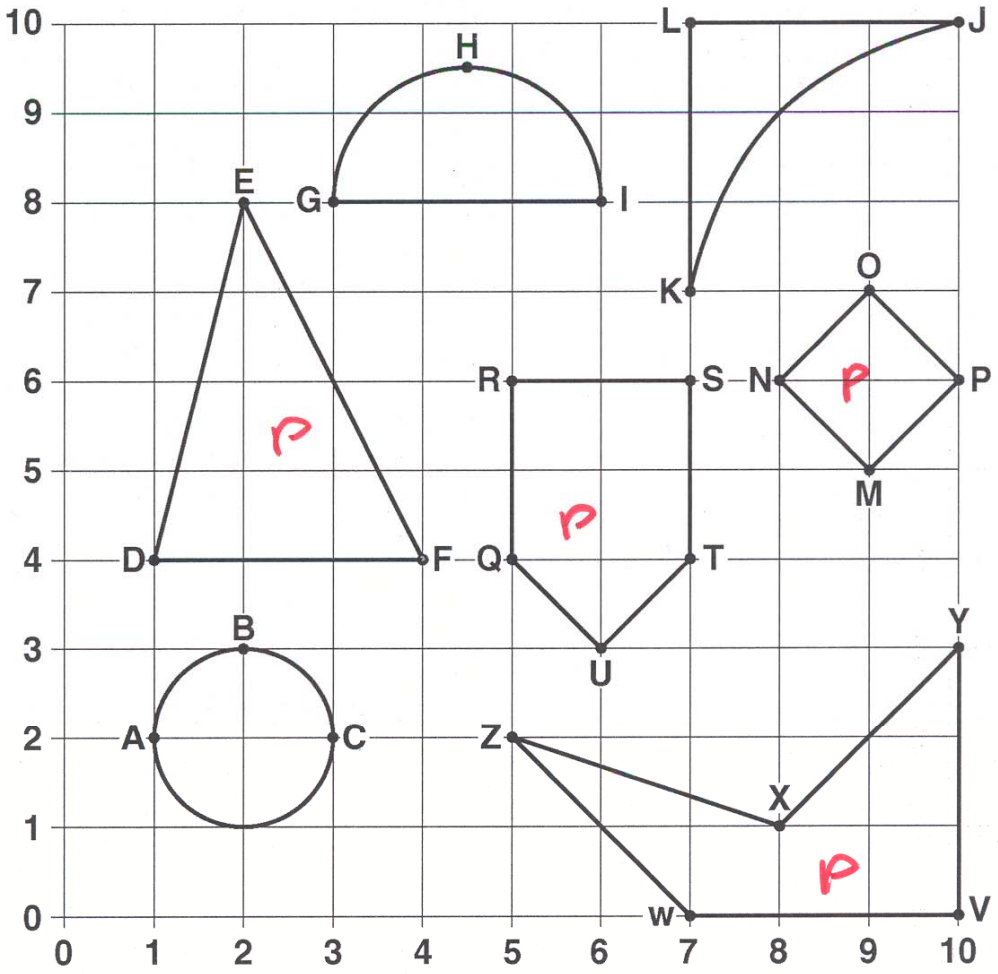
Grade 5–Planning Coordinate City

Name: ANSWER KEY Date: _____

1. The grid below shows the outlines of some buildings planned for Coordinate City.



a. Put the letter P inside each building with an outline shape that is a polygon.

How do you know the shapes you marked with a P are polygons and the other shapes are not polygons?

ALL SIDES OF A POLYGON ARE LINE SEGMENTS OR ARE STRAIGHT. SHAPES THAT ARE NOT POLYGONS HAVE SIDES THAT CURVE & ARE NOT STRAIGHT.

b. The sides of some buildings are parallel to the sides of other buildings. Write all the sides that are parallel to side XY.

UT _____ NO _____ MP _____

How can you tell?

THEY "RUN" IN THE SAME DIRECTION.

OR

THEY ALL GO FROM THE LOWER LEFT CORNER TO THE UPPER RIGHT CORNER OF A GRID SQUARE.

c. Name 2 sides of buildings that are perpendicular to each other.

NO and OP

OR: THERE ARE MANY PAIRS, SUCH AS NO & NM, OP & PM, NM & PM, RS & RQ, RS & ST, YV & WV, KL & LJ, ETC.

d. What are the coordinates of the point T?

(7 , 4)

NOTE: SIDES DO NOT NEED TO TOUCH, LIKE LJ & RQ.

Give the letter names of 3 points that have the same <u>first</u> coordinate as T.

L K S

AND W

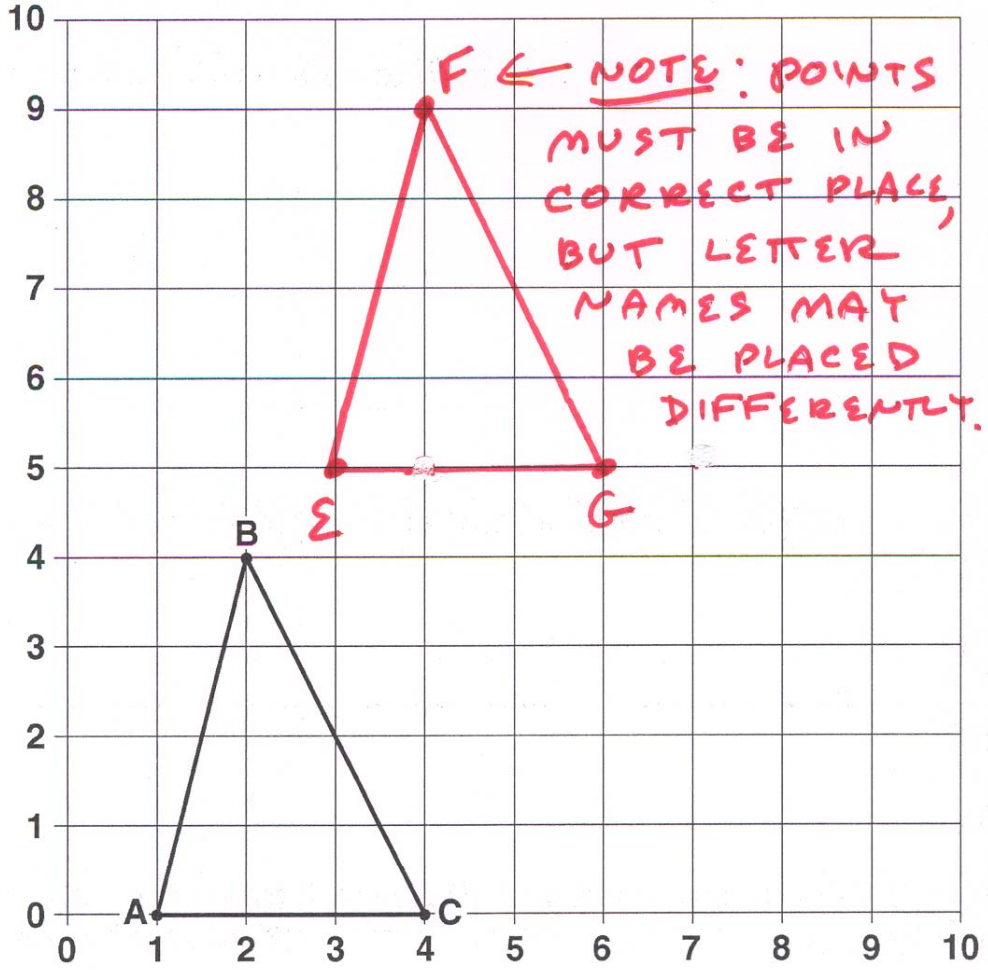
Give the letter names of 3 points that have the same <u>second</u> coordinate as T.

D F Q

Geometry
Grade 5–Planning Coordinate City

2. Shawna is helping to design buildings on the slide grid of the city. The shape of a building is on the grid below. It is called triangle ABC.

SLIDE GRID



Name the coordinates of points A, B, and C.

Point A: (1 , 0)

Point B: (2 , 4)

Point C: (4 , 0)

a. On the slide grid, you slide a shape to a new position to design a new building. There are 2 slides allowed on the grid.

- **Slide 1 must be right or left.**
- **Slide 2 must be up or down.**

Shawna decides to slide triangle ABC using the following slides.

- **Slide 1. Go right 2 numbers.**
- **Slide 2. Go up 5 numbers.**

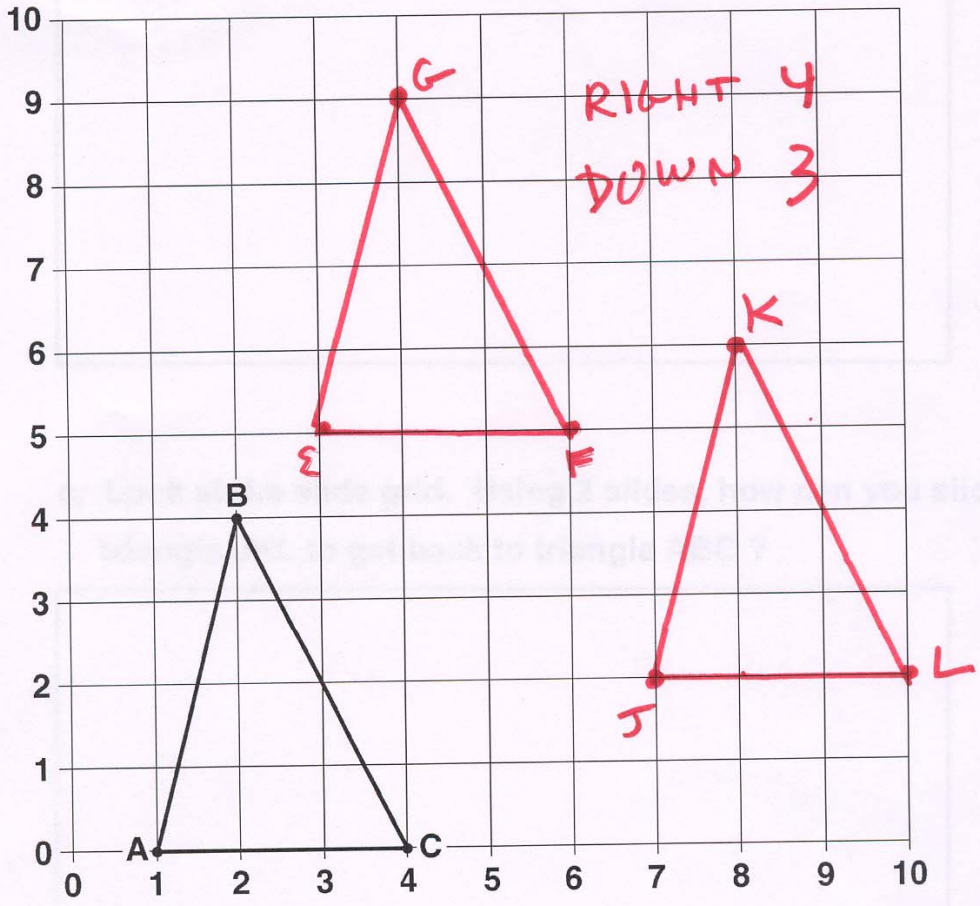
Follow Shawna's slides and draw the new triangle in the slide grid. Label the new triangle EFG.

How do you know you put the new triangle in the correct place?

The best response will discuss movement of the vertices of the triangle, such as, "I moved point A right 2 and up 5, I moved point B right 2 and up 5, and I moved point C right 2 and up 5." Student may also discuss adding numbers to coordinates, such as, "Point A is at (1, 0), so I added 2 to 1 and 5 to 0 to get point (3, 5)." Student may also talk of sliding just 1 point and then counting over and up from that point to get the rest of the triangle.

b. Put one more triangle on the slide grid. (You can put it anywhere on the grid.) Call the new triangle JKL.

There are many places that triangle JKL can be placed. You need to check each student's grid to be sure that the base line has length of 3 and the top vertex is 1 over and 4 up from the left base vertex. The number and direction of the slides must match. See example below:



If the student places a triangle between gridlines, this is ok as long as it is congruent to the original triangle ABC. However, the description of the slides need to include fractions.

b. Put one more triangle on the slide grid. (You can put it anywhere on the grid.) Call the new triangle JKL.

Using 2 slides, how can you slide triangle EFG to get to triangle JKL ?

SEE PREVIOUS PAGE.

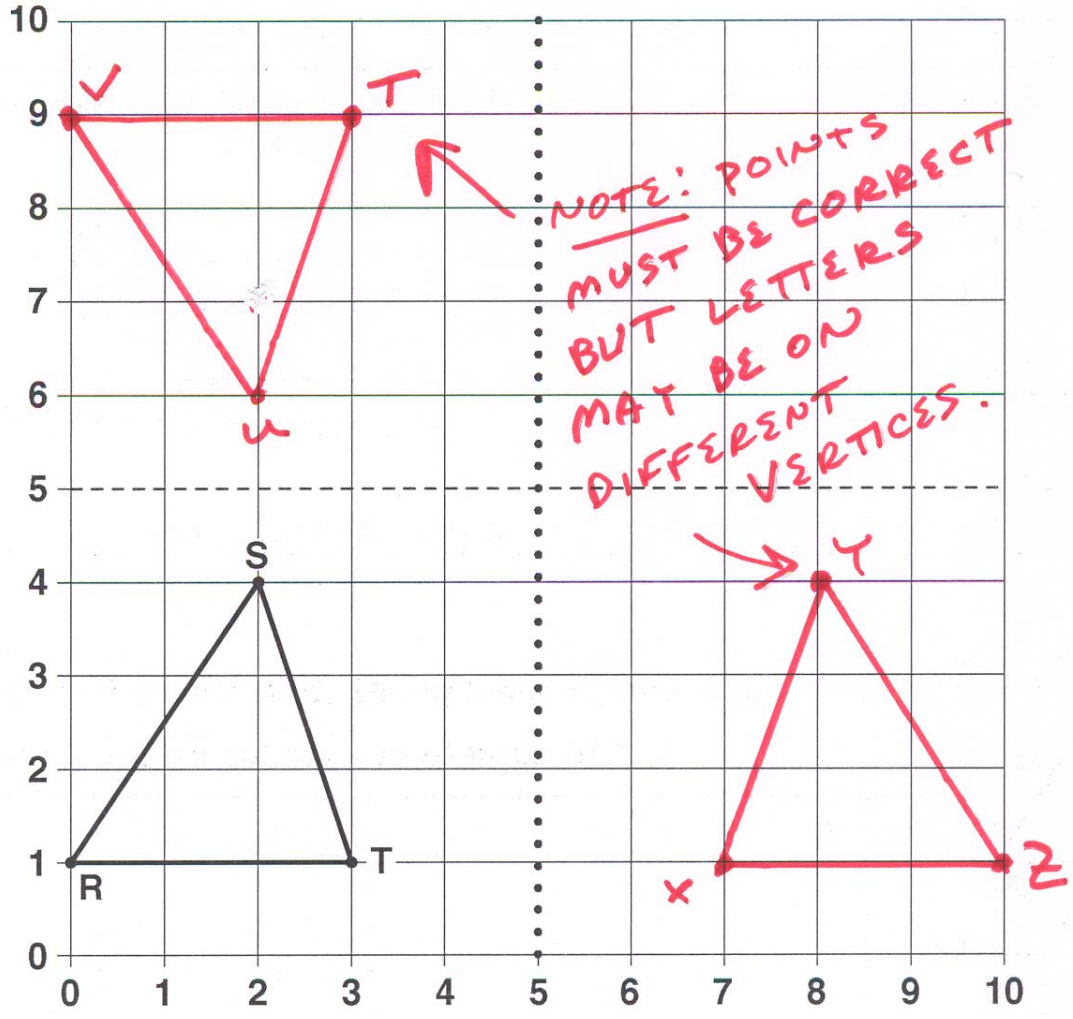
c. Look at the slide grid. Using 2 slides, how can you slide triangle JKL to get back to triangle ABC ?

USING THE EXAMPLE SHOWN,
LEFT 6
DOWN 2

BUT ANSWERS DEPEND ON STUDENT'S TRIANGLE.

3. Malcolm is helping to design buildings on the flip grid of the city. The shape of a building is on the grid below. It is called triangle RST.

FLIP GRID



Name the coordinates of points R, S, and T.

Point R: (0 , 1)

Point S: (2 , 4)

Point T: (3 , 1)

a. On the flip grid, you flip a shape to design a new building. There are 2 flips allowed on the grid.

- **You can flip over a horizontal line.**
- **You can flip over a vertical line.**

Malcolm decides to flip triangle RST using the following flip.

- **Flip over the horizontal line at 5.**

Find the dashed horizontal line at 5 on the flip grid. Follow Malcolm's flip and draw the new triangle. Label the new triangle UVW.

When the triangle is flipped, point R will be at a new point. What are the coordinates of the new point?

(0 , 9)

How do you know you put triangle UVW in the correct place?

The best response will discuss the vertical distance of each vertex from 5. Point R is 4 below 5, so it will flip to 4 above 5. Same for point T. Point S is only 1 below 5 and it flips to 1 above 5. Student may also indicate folding along the horizontal line to see where the triangle will fall.

b. Malcolm plans another new building. He decides to flip triangle RST over the <u>vertical</u> line at 5.

Find the dotted vertical line at 5 on the flip grid. Follow Malcolm's flip and draw the new triangle. Label the new triangle XYZ.

How do you know you put triangle XYZ in the correct place?

The best response will discuss the horizontal distance of each vertex from 5. Point R is 5 to the left of 5, so it will flip 5 to the right of 5. Point T is only 2 to the left and it will flip 2 to the right. Point S is 3 left of 5 and it will flip 3 right of 5. Student may talk of coordinates.

4. Which grid do you like better to work on? The slide grid or the flip grid? Explain why.

ANY RESPONSE IS FINE!

Geometry
Grade 5–Planning Coordinate City

Category	4	3	2	1
Mathematical concepts	**Response shows complete understanding of the mathematical concepts used to solve the problem(s).**	**Response shows substantial understanding of the mathematical concepts used to solve the problem(s).**	**Response shows some understanding of the mathematical concepts needed to solve the problem(s).**	**Response shows very limited understanding of the underlying concepts needed to solve the problem(s), OR the response is not written.**
	Response shows evidence in ALL of the following tasks. **Task 1**. Student is able to o describe characteristics of a polygon, o identify parallel and perpendicular line segments, o name coordinates of point T, and o name points on the same vertical and horizontal lines as T. **Task 2**. Student is able to o draw triangle EFG in the correct position on the grid, o draw a congruent triangle in another position, and o describe the slides necessary to move from one triangle to the other. **Task 3**. Student is able to o name coordinates of R, S, and T, o draw correct triangles after reflections, and o describe the reflection process.	Response shows evidence in all of the tasks described in category 4; may exhibit the following errors. **Task 1**. Student does not describe shapes that are not polygons; lacks clarity in description of parallel segments; reverses coordinates of points. **Task 2**. Student lacks clarity in description of slides. **Task 3**. Student reverses coordinates of points; lacks clarity in description of reflections.	Response shows evidence in only 2 of the tasks and may exhibit errors as described in category 3.	Response shows evidence in 1 or none of the tasks and may exhibit errors as described in category 3.

Category	4	3	2	1
Strategy and procedures	**Student typically uses an efficient and effective strategy to solve the problem(s).**	**Student typically uses an effective strategy to solve the problem(s).**	**Student sometimes uses an effective strategy to solve the problem(s), but not consistently.**	**Student rarely uses an effective strategy to solve the problem(s).**
	Response shows evidence in ALL of the following tasks. **Task 1**. Response shows evidence of pencil markings on grid to indicate parallel or perpendicular; evidence of pencil markings on grid to determine coordinates of point T; evidence of pencil markings on grid to determine vertical and horizontal directions from point T. **Task 2**. In part (a), response shows evidence of pencil markings on grid to indicate moving each vertex over 2 spaces and up 5 spaces, or evidence in the description that 2 and 5 were added to the respective coordinates. In part (b), response shows evidence of pencil markings on grid to determine placement of triangle, or evidence in the description of adding/subtracting numbers to coordinates. **Task 3**. In part (a), response shows evidence of pencil markings on grid to indicate flipping vertices over horizontal line, or evidence in the description of counting vertical distance from line. In part (b), response shows evidence of pencil markings on grid to indicate flipping vertices over vertical line, or evidence in the description of counting horizontal distance from line.	Response shows evidence in only 2 of the tasks described.	Response shows evidence in only 1 of the tasks described.	Response shows no evidence.

Common Core Mathematics Challenge

Geometry

Grade 5–Planning Coordinate City Rubric

Category	4	3	2	1
Explanation and communication	**Explanation is detailed and clear; uses appropriate terminology and/or notation.**	**Explanation is clear; uses some appropriate terminology and/or notation.**	**Explanation is a little difficult to understand, but includes critical components; shows little use of appropriate terminology and/or notation.**	**Explanation is difficult to understand, is missing several components, and does not use or include appropriate terminology and/or notation.**
	Response shows evidence in ALL of the following tasks. **Task 1**. Student explains that the sides of polygons are line segments AND that three of the shapes have a curved side (including the circle). Students explains that the parallel sides run in the same direction; a high-level response will discuss the slope of the lines as extending from the lower left corner to the upper right corner of each square grid. **Task 2**. In part (a), student uses the vertices to describe movement in the grid, either by referring to the movement of each point by name, or by referring to the coordinates of each point; may also refer to the relation of two vertices with respect to a single vertex. For parts (b) and (c), student correctly describes two slides based on the locations of the triangles. **Task 3**. In part (a), student describes vertical distance on the grid of each vertex to the line at y = 5 and describes how that distance is reflected over the line. In part (b), student describes horizontal distance of each vertex to the line x = 5 and describes how that distance is reflected over the line. **Task 4**. This is the opportunity to tell which they like better–sliding or flipping!	Response shows evidence in ALL of the tasks, but may lack detail in explanation, as evidenced by the following. **Task 1**. Student does not discuss when a shape is not a polygon. **Task 2**. Student does not discuss the vertices of the triangle, either by name or by coordinates. **Task 3**. Student does not discuss the vertices of the triangle, either by name or by coordinates.	Response shows evidence in only 1 or 2 explanations. Generally, student does not discuss triangle vertices.	No explanations given in the response.

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Grade 5–Planning Coordinate City Rubric

Category	4	3	2	1
Mathematical accuracy	**All or almost all of the steps and solutions have no mathematical errors.**	**Most of the steps and solutions have no mathematical errors.**	**Some of the steps and solutions have no mathematical errors.**	**Few of the steps and solutions have no mathematical errors.**
	Student provides correct answers for ALL of the following tasks and parts. **Task 1**. In part (a), student identifies 4 polygons, as shown on answer sheet. In part (b), student answers UT, NO and MP. In part (c), student gives at least 1 set of perpendicular segments, as listed on answer sheet. In part (d), student answers (7, 4), names at least 3 of points L, K, S, and W as having same first coordinate, and names D, F, and Q as having same second coordinate. **Task 2**. Student names correct coordinates of points A, B, and C, as shown on answer sheet. In part (a), student draws triangle with vertices at (3, 5), (6, 5), and (4, 9). In part (b), student draws another triangle that is congruent to ABC. **Task 3**. Student names correct coordinates of Points R, S and T, as shown on answer sheet. In part (a), student answers (0, 9) and draws a triangle with vertices at (0, 9), (2, 6), and (3, 9). In part (b), student draws a triangle with vertices at (7, 1), (10, 1), and (8, 4).	Student provides most of the correct answers for all tasks, but may exhibit the following errors. **Task 1**. In part (a), student identifies only 3 polygons. In part (d), student answers (4, 7). **Task 2**. Student names 1 pair of incorrect coordinates of points A, B, and C. **Task 3**. Student names 1 pair of incorrect coordinates of Points R, S and T, as shown on answer sheet. In part (a), student answers (9,0).	Student provides correct answers for only 2 of the tasks, and may exhibit errors as described in category 3.	Student provides a correct answer for only 1 task or none of the tasks, with errors as described in category 3.

Scoring Notes Checklist

Task	Check Yes	Category
Task 1		
Describes characteristics of a polygon. Identifies parallel and perpendicular line segments. Names coordinates of point T. Names points on the same vertical and horizontal lines as T.		Concept
Evidence of pencil markings on grid to indicate parallel or perpendicular. Evidence of pencil markings on grid to determine coordinates of point T. Evidence of pencil markings on grid to determine vertical and horizontal directions from point T.		Strategy
Explains that the sides of polygons are line segments AND that three of the shapes have a curved side (including the circle). Explains that the parallel sides run in the same direction. A high-level response will discuss the slope of the lines as extending from the lower left corner to the upper right corner of each square grid.		Explanation
Part (a): Identifies 4 polygons as shown on answer sheet. Part (b): Answers UT, NO and MP. Part (c): Gives at least 1 set of perpendicular segments, as listed on answer sheet. Part (d): Answers (7, 4). Names at least 3 of points L, K, S, and W as having same first coordinate. Names D, F, and Q as having same second coordinate.		Accuracy
Task 2		
Draws triangle EFG in the correct position on the grid. Draws a congruent triangle in another position. Describes the slides necessary to move from one triangle to the other.		Concept
In part (a), evidence of pencil markings on grid to indicate moving each vertex over 2 spaces and up 5 spaces. Or, evidence in the description that 2 and 5 were added to the respective coordinates. In part (b), evidence of pencil markings on grid to determine placement of triangle. Or evidence in the description of adding/subtracting numbers to coordinates.		Strategy
In part (a), uses the vertices to describe movement in the grid, either by referring to the movement of each point by name, or by referring to the coordinates of each point. May also refer to the relation of two vertices with respect to a single vertex. For parts (b) and (c), is able to correctly describe two slides based on the locations of the triangles.		Explanation
Names correct coordinates of points A, B, and C as given on answer sheet. In part (a), draws triangle with vertex coordinates at (3, 5), (6, 5), and (4, 9). In part (b), draws another triangle that is congruent to ABC.		Accuracy

Task	Check Yes	Category
Task 3		
Names coordinates of R, S, and T. Draws correct triangles after reflections. Describes the reflection process.		Concept
In part (a), evidence of pencil markings on grid to indicate flipping vertices over horizontal line. Or evidence in the description of counting vertical distance from line. In part (b), evidence of pencil markings on grid to indicate flipping vertices over vertical line. Or evidence in the description of counting horizontal distance from line.		Strategy
In part (a), describes the vertical distance on the grid of each vertex to the line y = 5 and describes how that distance is reflected over the line. In part (b), describes the horizontal distance of each vertex to the line x = 5 and describes how that distance is reflected over the line.		Explanation
Names correct coordinates of Points R, S and T as given on answer sheet. In part (a), answers (0, 9) and draws a triangle with vertex coordinates at (0, 9), (2, 6), and (3, 9). In part (b), draws a triangle with vertex coordinates at (7, 1), (10, 1), and (8, 4).		Accuracy
Task 4		
Students are rarely asked how they feel about something in mathematics. This is their opportunity to tell you which type of transformation–translation or reflection–they like better and why.		Explanation

Common Core Mathematics Challenge

Geometry
Grade 5–Planning Coordinate City

Analyzing Student Responses Protocol

The purpose of the Mathematics Challenges is to provide opportunities for students to develop and demonstrate understanding of important mathematical concepts and standards. They include extended responses, open-ended tasks, and tasks that require higher-order thinking skills. Because these types of tasks may be novel for students and they will have varying levels of understanding, the student responses will vary.

The guiding questions below were designed to assist you in analyzing your class' response to the Challenge and determining appropriate next steps for your teaching and learning.

Guiding Questions for Analyzing Student Responses to the Mathematics Challenges

1. When completing the Challenge, what did your students do well? How do you know?

2. When completing the Challenge, what did your students struggle with? How do you know?

3. When your students completed the Challenge, did they implement multiple correct solutions strategies? What insightful approaches to problem solving did you observe?

4. What, if any, patterns (e.g., common errors/misconceptions) did you observe across your student responses?

5. What questions or concerns did your students have when working through this Challenge or a particular task? Are these things you should address for the class as a whole?

6. What, if any, feedback did you provide to your class? How did you provide it?

7. What did you learn about your students' mathematical understanding based on their responses to this Challenge?