Atlanta Public Schools

Teacher's Curriculum Supplement

Mathematics I: Unit 6

This document has been made possible by funding from the GE Foundation Developing Futures grant, in partnership with Atlanta Public Schools. It is derived from the Georgia Department of Education Math I Frameworks and includes contributions from Georgia teachers. It is intended to serve as a companion to the GA DOE Math I Frameworks Teacher Edition. Permission to copy for educational purposes is granted and no portion may be reproduced for sale or profit.

Preface

We are pleased to provide this supplement to the Georgia Department of Education's Mathematics I Framework. It has been written in the hope that it will assist teachers in the planning and delivery of the new curriculum, particularly in this first year of implementation. This document should be used with the following considerations.

- The importance of working the tasks used in these lessons cannot be overstated. In planning for the teaching of the Georgia Performance Standards in Mathematics teachers should work the task, read the teacher notes provided in the Georgia Department of Education's Mathematics I Framework Teacher Edition, and *then* examine the lessons provided here.

- This guide provides day-by-day lesson plans. While a detailed scope and sequence and established lessons may help in the implementation of a new and more rigorous curriculum, it is hoped that teachers will assess their students informally on an on-going basis and use the results of these assessments to determine (or modify) what happens in the classroom from one day to the next. Planning based on student need is much more effective than following a pre-determined timeline.

- It is important to remember that the Georgia Performance Standards provide a balance of concepts, skills, and problem solving. Although this document is primarily based on the tasks of the Framework, we have attempted to help teachers achieve this all important balance by embedding necessary skills in the lessons and including skills in specific or suggested homework assignments. The teachers and writers who developed these lessons, however, are not in your classrooms. It is incumbent upon the classroom teacher to assess the skill level of students on every topic addressed in the standards and provide the opportunities needed to master those skills.

- In most of the lesson templates, the sections labeled *Differentiated support/enrichment* have been left blank. This is a result of several factors, the most significant of which was time. It is also hoped that as teachers use these lessons, they will contribute their own ideas, not only in the areas of differentiation and enrichment, but in other areas as well. Materials and resources abound that can be used to contribute to the teaching of the standards.

On the topic of differentiation, it is critical to reiterate that many of the strategies used in a standards-based mathematics classroom promote differentiation. These strategies include

- the use of rich tasks with multiple points of entry and more than one path to a solution,
- flexible grouping of students,
- multiple representations of mathematical concepts,
- writing in mathematics,
- monitoring of progress through on-going informal and formative assessments, and
- analysis of student work.

We hope that teachers will incorporate these strategies in each and every lesson. It is hoped that you find this document useful as we strive to raise the mathematics achievement of all students in our district and state. Comments, questions, and suggestions for inclusions related to the document may be emailed to Dr. Dottie Whitlow, Executive Director, Mathematics and Science Department, Atlanta Public Schools, dwhitlow@atlantapublicschools.us

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Explanation of the Terms and Categories Used in the Lesson Template

Task: This section gives the suggested number of days needed to teach the concepts addressed in a task, the task name, and the problem numbers of the task as listed in the Georgia Department of Education's Mathematics I Framework Teacher Edition (GaDOE TE).

In some cases new tasks or activities have been developed. These activities have been named by the writers.

Standard(s): Although each task addresses many Math I standards and uses mathematics learned in earlier grades, in this section, only the key standards addressed in the lesson are listed.

New Vocabulary: Vocabulary is only listed here the first time it is used. It is strongly recommended that teachers, particularly those teaching Math Support, use interactive word walls. Vocabulary listed in this section should be included on the word walls.

Mathematical concepts/topics: Major concepts addressed in the lesson are listed in this section whether they are Math I concepts or were addressed in earlier grades.

Prior knowledge: Prior knowledge includes only those topics studied in previous grades. It does not include Math I content taught in previous lessons.

Essential Question(s): Essential questions may be daily and/or unit questions.

Suggested materials: This is an attempt to list all materials that will be needed for the lesson, including consumable items, such as graph paper; and tools, such as graphing calculators and compasses. This list does not include those items that should always be present in a standards-based mathematics classroom such as markers, chart paper, and rulers.

Warm-up: A suggested warm-up is included with every lesson. Warm-ups should be brief and should focus student thinking on the concepts that are to be addressed in the lesson.

Opening: Openings should set the stage for the mathematics to be done during the work time. The amount of class time used for an opening will vary from day-to-day but this should not be the longest part of the lesson.

Worktime: The problem numbers have been listed and the work that students are to do during the worktime has been described. A student version of the day's activity follows the lesson template in every case. In order to address all of the standards in Math I, some of the problems in some of the tasks have been omitted and less time consuming activities have been substituted for those problems. In many instances, in the student versions of the tasks, the writing of the original tasks has been simplified. In order to preserve all vocabulary, content, and meaning it is important that teachers work the original tasks as well as the student versions included here.

Teachers are expected to both facilitate and provide some direct instruction, when necessary, during the work time. Suggestions related to student misconceptions, difficult concepts, and deeper meaning have been included in this section. However, the teacher notes in the GaDOE Math I Framework are exceptional. In most cases, there is no need to repeat the information provided there. Again, it is imperative that teachers work the tasks and read the teacher notes that are provided in GaDOE support materials.

Questioning is extremely important in every part of a standards-based lesson. We included suggestions for questions in some cases but did not focus on providing good questions as extensively as we would have liked. Developing good questions related to a specific lesson should be a focus of collaborative planning time.

Closing: The closing may be the most important part of the lesson. This is where the mathematics is formalized. Even when a lesson must be continued to the next day, teachers should stop, leaving enough time to "close", summarizing and formalizing what students have done to that point. As much as possible students should assist in presenting the mathematics learned in the lesson. The teacher notes are all important in determining what mathematics should be included in the closing.

Homework: In some cases, homework suggestions are provided. Teachers should use their resources, including the textbook, to assign homework that addresses the needs of their students.

Homework should be focused on the skills and concepts presented in class, relatively short (30 to 45 minutes), and include a balance of skills and thought-provoking problems.

Differentiated support/enrichment: On the topic of differentiation, it is critical to reiterate that many of the strategies used in a standards-based mathematics classroom promote differentiation. These strategies include

- the use of rich tasks with multiple points of entry and more than one path to a solution
- flexible grouping of students
- multiple representations of mathematical concepts
- writing in mathematics
- monitoring of progress through on-going informal and formative assessments
- and analysis of student work.

Check for understanding: A check for understanding is a short, focused assessment-a ticket out the door, for example. The Coach Book may be a good resource for these items.

Resources/materials for Math Support: Again, in some cases, we have provided materials and/or suggestions for Math Support. This section should be personalized to your students, class, and/or school, based on your resources.

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Unit 6

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Unit 6 Timeline

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Task 4: Euler's Village	1 day
Task 5: The House	1 day

Task Notes

Task 1: Video Game
All parts of the GaDOE TE task are included in these lesson plans with small modifications in wording for clarification.. Problem numbers have been adjusted to correct numbering errors in the DOE document. Problems now numbered 10 – 15 have been assigned as homework in order to limit the class time needed to complete the task. Concepts addressed in these problems were taught in the middle grades so students should be capable of completing them on their own. It is imperative however, that these problems be utilized as the opening for Day 2 in preparation for completing the remaining parts of the task.

Task 2: New York, New York!
Problems 3 – 5 of the GaDOE TE have been revised. Notes related to these problems can still be found in the DOE Teacher Notes and in the Worktime section of the lesson plan included in this supplement.

Task 3: Quadrilaterals Revisited
All parts of the GaDOE TE are included in these lesson plans. It is suggested that the task be introduced with problem 14 as a more "open-ended" way of "setting the stage" for the mathematics addressed in the task. It is also suggested that problems 1 – 8 be completed during class, problems 9 – 13 be assigned as homework problems, and problem 15 be used as a check for understanding. While it may not be necessary to complete all problems in this task, problems 14 and 15 are excellent and should be addressed.

Task 4: Euler's Village
All parts of the GaDOE task are included in these lesson plans.

Task 5: The House
This task is not contained in the GaDOE Framework. It provides additional practice in most of the skills developed in this unit. (NOTE: The House Task is still in development and will be sent to APS teachers as soon as possible.)

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Mathematics I: Unit 6

Task 1: Video Game

Mathematics I
Task 1: Video Game **Day 1/2**
(GaDOE TE # 1 - #9)

Standard(s): MM1G1: Students will investigate properties of geometric figures in the coordinate plane.

a. Determine the distance between two points.
d. Understand the distance formula as an application of the Pythagorean Theorem.

New vocabulary:

Mathematical concepts/topics: use the coordinate plane to help solve real world problems, appropriate scales, rates of change, distance between two points on a number line, distance between two points in the plane as an application of the Pythagorean Theorem

Prior knowledge: graphing in the coordinate plane, Pythagorean Theorem, rates of change, distance between two points on a number line

Essential question(s): How can I use the coordinate plane to help solve real world problems?

Suggested materials: calculators, graph paper

Warm-up: Post the following:

Enrique is riding on a bike path at approximately 13 miles per hour. The path has distance markers every 1/4 mile. If he passed the 3 ¾ mile marker at 2:30, what marker should he pass at approximately 3:15?

Opening: After discussing the warm-up, ask students to read the introduction to the task, making notes in the margins of important information. When students have had time to read the scenario silently, discuss the situation. Be sure students understand starting positions, directions of movement, and speeds of both players. Do not represent the situation in the plane for students. It is important that they be given the opportunity to investigate the use of the coordinate plane as a tool for solving problems.

Worktime: Students should work in pairs or groups to complete problems 1 –9 of the task. Give them a short period of time to sketch the movement of the tokens on graph paper before having a whole class discussion on scale. Hopefully some students will have discovered (and be able to share) that a scale of .1 inch is most useful in graphing the positions of the tokens at various times.

Students should use the Pythagorean Theorem to determine the distances between the tokens at various times t. Monitor student work carefully during the worktime to be sure that students are competent in determining the lengths of the legs of the triangles and then using those lengths to find the length of the hypotenuse. Calculators should be provided to help with the computation.

Closing: Discuss problems 6 – 8 of the task. Note that a specific time does not need to be determined for problem 6 at this point. Students should see that the tokens will be exactly ¼ inch apart at 1 ¼ seconds. (See teacher notes.)

Homework: Problems 10 – 15 of the task. Given the work done in class and previous experience with the coordinate plane, students should be able to complete these problems as homework. (They will need a ruler.) Be sure to emphasize to them that completion of this work is imperative for the next lesson.

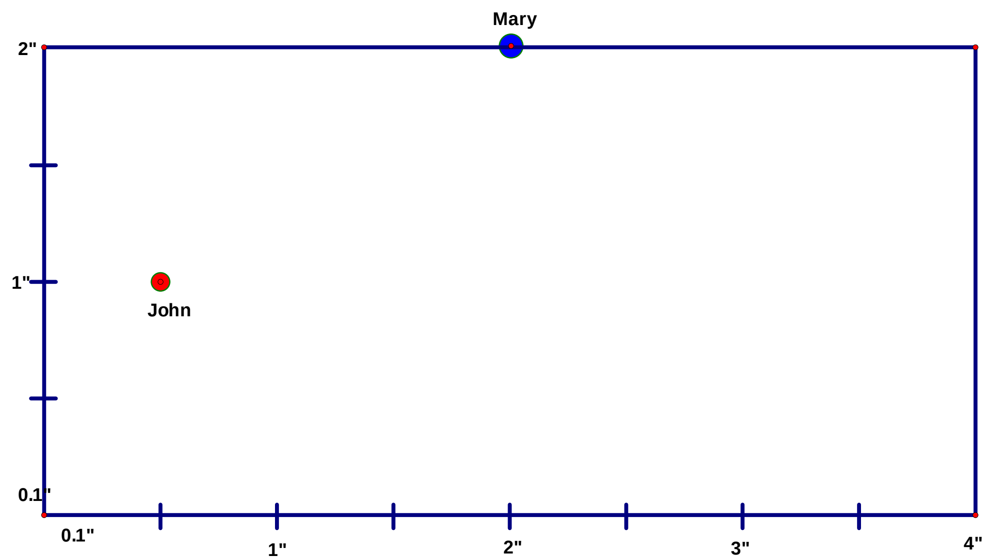
Differentiated support/enrichment:

Check for Understanding:

Resources/materials for Math Support: Give students opportunities to represent various situations using the coordinate plane. Emphasis should be placed on those ideas contained in the task, including scale, starting position, direction of movement, and speed.

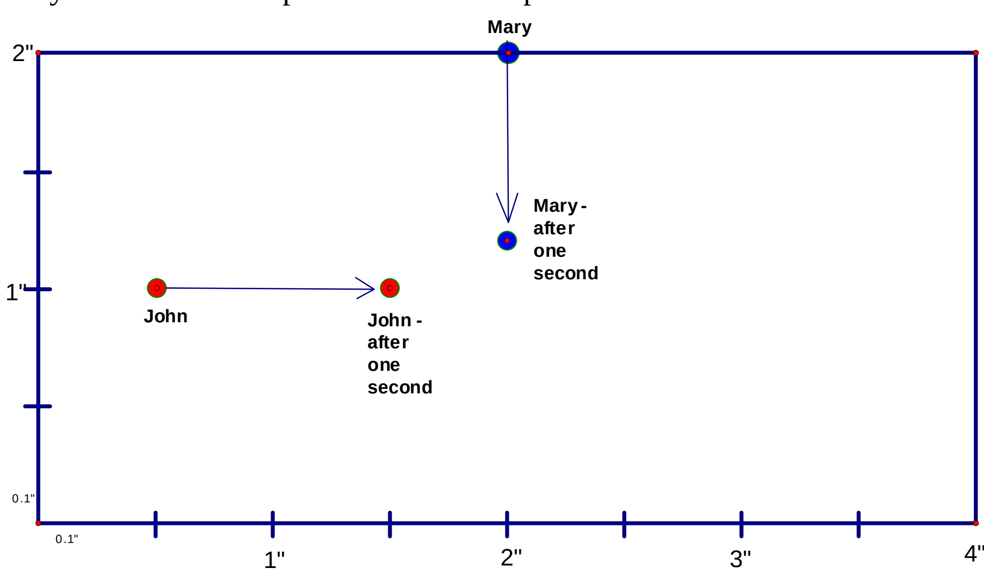
Mathematics I
Video Game
Day 1 Student Task

John and Mary are fond of playing retro style video games on hand held game machines. They are currently playing a game on a device that has a screen that is 2 inches high and four inches wide. The game starts with John's token ½ inch from the left edge and half way between the top and bottom of the screen. Mary's token starts out at the extreme top of the screen and exactly at the midpoint of the top edge.



Starting Position

As the game begins, John's token moves directly to the right at a speed of 1 inch per second. For example, John's token moves 0.1inches in 0.1 seconds, 2 inches in 2 seconds, etc. Mary's token moves directly downward at a speed of 0.8 inches per second.



After One Second

Let time be denoted in this manner: $t = 1$ means the positions of the tiles after one second

1. Draw a picture on graph paper showing the positions of both tokens at times $t = 1/4$, $t = 1/2$, $t = 1$, and other times of your choice.

2. Discuss the movements possible for John's token.

3. Discuss the movements possible for Mary's token.

4. Discuss the movements of both tokens relative to each other.

5. Find the distance between John and Mary's tokens at times $t = 0$, $t = 1/4$, $t = 1/2$, $t = 1$.

If Mary's token gets closer than ¼ inch to John's token, then Mary's token will destroy John's, and Mary will get 10,000 points. However, if John presses button A when the tokens are less than 1/2 inch apart and more than ¼ inch apart, then John's token destroys Mary's, and John gets 10,000 points.

6. Find a time at which John can press the button and earn 10,000 points. Draw the configuration at this time.

7. Compare your answers with your group. What did you discover?

8. Estimate the longest amount of time John could wait before pressing the button.

9. Drawing pictures gives an estimate of the critical time, but inside the video game, everything is done with numbers. Describe in words the mathematical concepts needed in order for this video game to work.

Mathematics I
Homework
Day 1

To help us think about the distance between the tokens in our video game, it may help us to look first at a one-dimensional situation. Let's look at how you determine distance between two locations on a number line:

10. What is the distance between 5 and 7? 7 and 5? -1 and 6? 5 and -3?

11. Can you find a formula for the distance between two points, *a* and *b*, on a **number line**?

Now that you can find the distance on a number line, let's look at finding distance on the coordinate plane:

12. Plot the points A= (0, 0), B = (3, 0) and C = (3, 4) on centimeter graph paper.

13. Find the distance from the point (0, 0) to the point (3, 4) using a ruler.

14. Consider the triangle ABC, what kind of triangle is formed? Find the lengths of the two shorter sides. Use these lengths to calculate the length of the hypotenuse. Is this consistent with your prior measurement? Why or why not?

15. Using the same graph paper, find the distance between:
    a. (1 , 1) and (4, 4)
    b. (- 1, 1) and (11, 6)
    c. (-1, 2) and (2, -6)

Mathematics I
Task 1: Video Game **Day 2/2**
(GaDOE TE # 16 - #27)

Standard(s): MM1G1: Students will investigate properties of geometric figures in the coordinate plane.

b. Determine the distance between two points.
d. Understand the distance formula as an application of the Pythagorean Theorem.

New vocabulary:

Mathematical concepts/topics: use of the coordinate plane to help solve real world problems, formula for the distance between two points on a number line, derivation of the formula for the distance between two points in the plane, translation from verbal to graphical to algebraic expressions, use of the *x*-coordinates of points of intersection to solve inequalities of the type $a \leq f(x) \leq b$

Prior knowledge: graphing in the coordinate plane, Pythagorean Theorem, rates of change, distance between two points on a number line

Essential question(s): How can I use the coordinate plane to help solve real world problems?

Suggested materials: graphing calculators, graph paper

Warm-up: Allow students to compare homework from the previous lesson with a partner.

Opening: Discuss the homework as preparation for the remaining parts of the task. Discussion should lead students to the following understandings:

- The distance between any two points a and b on the number line can be represented as $|a - b|$ or $|b - a|$.
- The legs of the right triangles in problem 15 are parallel to the *x*- and the *y*- axes. Their lengths can be determined by subtracting the *x*- coordinates of their endpoints if they are horizontal segments or the *y*-coordinates of the endpoints if they are vertical segments.

Part *b* or *c* of problem 15 should be discussed thoroughly since these problems deal with points in quadrants other than the first quadrant.

Worktime: Students should work in pairs or groups to complete problems 16 through 27 of the task. Allow students time to develop their own formulas for the distance between two points (problems 16 – 18) and then test those formulas (problem 21) against the distances they found using the Pythagorean Theorem (problem 5). Encourage them to make revisions to their formulas, if needed. Once students have had time to develop and check their formulas, whole class discussion should be held to ensure that all students have a correct formula and that standard notation for the formula is used. (See teacher notes for problems 16 – 18.) All students should have a correct formula before proceeding on to problem 22.

Monitor student work carefully during the worktime. Encourage students to create tables such as those in the teacher notes when answering question 20. In problem 23, they are asked to write algebraic expressions to represent coordinates. Encourage the use of all representations developed throughout the task (verbal descriptions given at the beginning of the task, geometric representations drawn in the coordinate plane, and the tables developed in problem 20) to assist in answering this question.

Closing: Discuss problems 22 - 27. (See teacher notes.)

Homework:

1. Write the statements below using absolute value notation:
   a. The distance between *x* and 4 is 3.
   b. The distance between *y* and – 2 is greater than or equal to 4.

2. Find the area and the perimeter of the figure determined by the points (- 5, 3), (0, - 1), and (4, 4).

Differentiated support/enrichment:

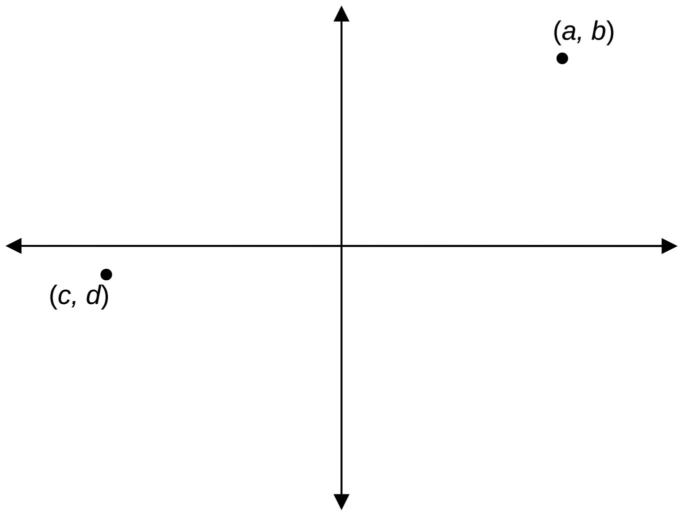
Check for Understanding:

Resources/materials for Math Support: Students may need to preview the following concepts and skills:

- Deriving the formula for the distance between two points on a number line.
- Using the Pythagorean Theorem to find the distance between two points in the plane. This work should include having students draw the necessary right triangle and determine the missing vertex.
- Representing coordinates of ordered pairs as algebraic expressions. Examples should be in varying contexts and similar to the work required in the task.

Mathematics I
Video Game
Day 2 Student Task

16. Find the distance between points (a, b) and (c, d) shown below.



17. Using your solutions from 16, find the distance between the point (x_1, y_1) and the point (x_2, y_2). Solutions written in this generic form are often called formulas.

18. Do you think your formula would work for any pair of points? Why or why not?

Let's revisit the video game. Draw a diagram of the game on a coordinate grid placing the bottom left corner at the origin.

19. Place John and Mary's tokens at the starting positions.

20. Write an ordered pair for John's token and an ordered pair for Mary's token when t = 0, when t = ½, when t = 1 ½, and when t = 2.

21. Find the distance between their tokens when t = 0, when t = ½, when t = 1 ½, and when t = 2.

22. Write an ordered pair for John and Mary's tokens at any time t.

23. Write an equation for the distance between John and Mary's tokens at any time t.

24. Using a graphing utility, graph the equation you derived for the distance between the two tokens.

25. What does the graph look like? What are the characteristics of this graph?

26. What do the variables represent?

27. Recall that when John and Mary are between ¼ and ½ inches apart, John may press the button to earn 10,000 points. What interval of time represents John's window of opportunity to score points?

Mathematics I
Homework
Day 2

1. Write the statements below using absolute value notation:
    a. The distance between *x* and 4 is 3.
    b. The distance between *y* and – 2 is greater than or equal to 4.

2. Find the area and the perimeter of the figure determined by the points (- 5, 3), (0, - 1), and (4, 4).

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Mathematics I: Unit 6

Task 2: New York, New York!

Mathematics I
Task 2: New York, New York! **Day 1/1**
(GaDOE TE # 1 – 3, 5 and 6)

MM1G1: Students will investigate properties of geometric figures in the coordinate plane.

a. Determine the distance between two points.
c. Determine the midpoint of a segment.

New vocabulary: midpoint of a line segment

Mathematical concepts/topics: use of grids and the coordinate plane to solve real-world problems, the midpoint of a line segment, derivation of the formula for finding the midpoint of any line segment, distance between two points in the plane

Prior knowledge: graphing in the coordinate plane, Pythagorean Theorem, distance between two points on a number line

Essential question(s): How can I find the coordinates of the midpoint of a line segment?

Suggested materials: graph paper

Warm-up: Project the first two paragraphs of the task. Allow students to work in pairs to draw a grid of New York City streets and avenues. Each student should draw their own grid on graph paper.

Opening: Allow students to discuss the grid. Make sure that all students have the correct sketch before beginning problem 1.

Worktime: Students should work in pairs to complete the task. Problems 3 – 6 contain revisions to the original DOE task.

As you monitor student work, you should note the following:

- In problem 3, students consider first the *walking* distance between Emily's apartment and the hotel. Remind them that in cities you cannot usually walk the shortest distance but rather must walk the number of blocks necessary to get from one place to another.
- In problem 4, students consider the actual or straight line distance from the apartment to the hotel. They may find this distance using coordinates from the grid and the distance formula or by using the Pythagorean Theorem.
- In problem 5, students are asked to find the midpoint of the line segment connecting the apartment and the hotel. Allow them to use their own methods for finding this point and insist that they explain their thinking.
- Problem 6 extends the thinking begun in problem 5 to a specific line segment in the coordinate plane. Again, allow students to use their own methods for finding this midpoint.

- The work done in the previous problems should help students generalize their thinking in problem 7 to any segment. Ask guiding questions that will lead students to the idea of averaging coordinates to find the midpoint.

Closing: Allow students to share their work.

Homework:

1. Find the midpoints of the line segments with the following endpoints:
   a. (-1, 3) and (5, 9)
   b. (- 7/3, ¾) and (5/3, - 9/4)
   c. (5, - 2) and (- 1, - 4)

2. A circle has a center at (- 2, 4) and one endpoint of a diameter at (1, 6). Find the other endpoint of the diameter using two different methods.

3. Let the point P with coordinates (*a, b*) be a point in the first quadrant. Find the coordinates of the point Q in the third quadrant so that the origin is the midpoint of the segment PQ.

Differentiated support/enrichment:

Check for Understanding:

Resources/materials for Math Support: Students should continue to work with grids. Discussions of direction (east, west, north, and south) should be included.

Mathematics I
New York, New York!
Student Task

Emily works at a building located on the corner of 9th Avenue and 61st Street in New York City. Her brother, Gregory, is in town on business. He is staying at a hotel at the corner of 9th Avenue and 43rd Street.

The streets of New York City were laid out in a rectangular pattern. In this part of town, Avenues run in a North-South direction and they are numbered from east to west, in other words the further east you go, the lower the number. That means the Avenues east of 9th Ave are 8th Ave, 7th Ave, etc. Streets run in an east-west direction. They increase in number as you proceed north. So, north of 41st Street is 42nd Street, then 43rd Street, etc. The distance between the avenues is the same as the distance between the streets. All the blocks are approximately the same size.

1. Gregory called Emily at work, and they agree to meet for lunch. They agree to meet at a corner half way between Emily's work and Gregory's hotel. Where should they meet? Justify your answer using a diagram.

2. After lunch, Emily has the afternoon off and wants to show Gregory her apartment. Her apartment is three blocks north and four blocks west of the hotel. At what intersection is her apartment building located?

3. Gregory walks back to his hotel for an afternoon business meeting. He and Emily are going to meet for dinner. They decide to be fair and will meet half way.
   a. What is the *walking* distance from Emily's apartment to Gregory's hotel?
   b. Where should they meet for dinner?
   c. How far are they going to walk to meet?
   d. Is their walking distance ½ the distance from Emily's apartment and Gregory's hotel? Why or why not?

4. What is the actual distance from Emily's apartment to Gregory's hotel? Justify your answer.

5. Suppose Emily and Gregory *could* walk a straight line between her apartment and the hotel. If they agreed to meet halfway, where would they meet? Explain how you got your answer.

On appropriate graph paper, plot the points A = (6, 0), and B = (4, 12).

6. The point midway between A and B is called the **midpoint** of the segment AB. Find this point. Explain how you got your answer. Check using distances.

7. Find the midpoint of a segment whose endpoints are (x_1, y_1) and (x_2, y_2). Would this formula work for any endpoints? Why or why not?

Mathematics I
Homework

1. Find the midpoints of the line segments with the following endpoints:
   a. (-1, 3) and (5, 9)
   b. (- 7/3, ¾) and (5/3, - 9/4)
   c. (5, - 2) and (- 1, - 4)

2. A circle has a center at (- 2, 4) and one endpoint of a diameter at (1, 6). Find the other endpoint of the diameter using two different methods.

3. Let the point P with coordinates (a, b) be a point in the first quadrant. Find the coordinates of the point Q in the third quadrant so that the origin is the midpoint of the segment PQ.

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Task 3: Quadrilaterals Revisited

Mathematics I
Task 3: Quadrilaterals Revisited **Day 1/1**
(GaDOE TE #14, and 1 - 8)

MM1G1: Students will investigate properties of geometric figures in the coordinate plane.

a. Determine the distance between two points.
c. Determine the midpoint of a segment.
d. Understand the distance formula as an application of the Pythagorean Theorem.
e. Use the coordinate plane to investigate properties of and verify conjectures related to triangles and quadrilaterals.

New vocabulary:

Mathematical concepts/topics: use of the coordinate plane to investigate and verify properties of geometric figures, slope, slopes of parallel and perpendicular lines, midpoint of line segment, distance between two points in the plane, proof using the triangle congruence postulates

Prior knowledge: graphing in the coordinate plane, slope, slopes of parallel and perpendicular lines

Essential question(s): How can I use the coordinate plane to investigate properties of quadrilaterals?

Suggested materials: graph paper

Warm-up: Post problem 14 of the task and make sure that all students have graph paper.

> *Plot points A = (1, 0), B = (-1, 2), and C = (2, 5). Find the coordinates of a fourth point D that would make ABCD a rectangle. Justify that ABCD is a rectangle.*

Have students work alone for a period of time. Then allow them to work with a partner to either continue to solve the problem or to verify the solutions they have found. Be sure to allow sufficient time for students to "struggle" with the problem. This may take significantly more time than the usual warm-up.

Monitor student progress, asking guiding questions when needed. Look for alternate approaches that can be shared during the opening.

Opening: Allow students to share their work. Ask questions that will foster discussion of the following:

- slopes of perpendicular lines are negative reciprocals
- slopes of parallel lines are equal
- opposite sides of a rectangle are parallel and congruent
- adjacent sides of a rectangle are perpendicular
- diagonals of a rectangle bisect each other

Worktime: Students should complete problems 1 – 8 of the task. Problems 1 – 13 are composed of sets of similar questions related to 3 different quadrilaterals. The first two quadrilaterals are addressed in problems 1 – 8. The third quadrilateral is addressed in problems 9 – 13. Students should be able to finish problems 9 - 13 for homework, if a sufficient closing is conducted during the class period.

Closing: Allow students to share their work. See teacher notes.

Homework: Problems 9 – 13 of the task.

Check for Understanding: Problem 15 of the task. This is an excellent problem. Students should be given sufficient time to complete the problem and it should be thoroughly discussed in class.

> *Plot points A = (1, 0), B = (-1, 2), and C = (2, 5). Find the coordinates of a fourth point D that would make ABCD a parallelogram that is not also a rectangle. Justify that ABCD is a parallelogram but is not a rectangle.*

Resources/materials for Math Support: Students should review/preview slopes of parallel and perpendicular lines, properties of special quadrilaterals, and proof using the triangle congruence postulates.

Mathematics I
Quadrilaterals Revisited
Student Task

Plot points A = (-3, -1), B = (-1, 2), C = (4, 2), and D = (2, -1).

1. What specialized geometric figure is quadrilateral ABCD? Support your answer mathematically.

2. Draw the diagonals of ABCD. Find the coordinates of the midpoint of each diagonal. What do you notice?

3. Find the slopes of the diagonals of ABCD. What do you notice?

4. The diagonals of ABCD create four small triangles. Are any of these triangles congruent to any of the others? Why or why not?

Plot points E = (1, 2), F = (2, 5), G = (4, 3) and H = (5, 6).

5. What specialized geometric figure is quadrilateral EFHG? Support your answer mathematically using two different methods.

6. Draw the diagonals of EFHG. Find the coordinates of the midpoint of each diagonal. What do you notice?

7. Find the slopes of the diagonals of EFHG. What do you notice?

8. The diagonals of EFHG create four small triangles. Are any of these triangles congruent to any of the others? Why or why not?

Mathematics I
Quadrilaterals Revisited
Homework

Plot points P = (4, 1), W = (-2, 3), M = (2,-5), and K = (-6, -4).

9. What specialized geometric figure is quadrilateral PWKM? Support your answer mathematically.

10. Draw the diagonals of PWKM. Find the coordinates of the midpoint of each diagonal. What do you notice?

11. Find the lengths of the diagonals of PWKM. What do you notice?

12. Find the slopes of the diagonals of PWKM. What do you notice?

13. The diagonals of ABCD create four small triangles. Are any of these triangles congruent to any of the others? Why or why not?

Atlanta Public Schools

Teacher's Curriculum Supplement

Mathematics I: Unit 5

Task 4: Euler's Village

Mathematics I
Task 4: Euler's Village **Day 1/1**
(GaDOE TE # 1 - 5)

MM1G1: Students will investigate properties of geometric figures in the coordinate plane.

a. Determine the distance between two points.
b. Determine the distance between a point and a line.
d. Understand the distance formula as an application of the Pythagorean Theorem.

New vocabulary:

Mathematical concepts/topics: use of the coordinate plane to investigate and verify properties of geometric figures, slope, slopes of perpendicular lines, distance between two points in the plane, writing an equation of a line given the slope and one point, solving systems of two linear equations in two unknowns, the distance between a point and a line postulates

Prior knowledge: graphing in the coordinate plane, slope, slopes of parallel and perpendicular lines, writing an equation of a line given the slope and one point, solving systems of two linear equations in two unknowns

Essential question(s): How can I use the coordinate plane to solve problems?

Suggested materials: graph paper

Warm-up: Project the first two paragraphs of the task. Allow students to work in pairs to make a sketch of the village.

Opening: Have someone read the scenario aloud and then allow students to discuss their sketches. A good scale for this sketch is 1 unit = 100 yards. Students may not understand what is meant by a northeast direction.

Worktime: Students should complete problems 1 – 5 of the task.

Closing: Allow students to share their work. It is important to discuss problem 4 in order to help them understand and internalize the steps needed to find the distance between a point and a line. There is a formula for finding this distance but students should NOT be expected to learn it. (See teacher notes.)

Homework: Students will need more practice in solving systems of equations, writing the equations of lines, and finding the distance between a point and a line.

Check for Understanding:

Resources/materials for Math Support: Students should review/preview writing equations of lines given the slope and the *y*-intercept, two points, and the slope and one point; and solving systems of two linear equations in two unknowns.

Mathematics I
Euler's Village
Student Task

You would like to build a house close to the village of Euler. There is a beautiful town square in the village, and the road you would like to build your house on begins right at the town square.

The road follows a northeast direction as you leave town and continues for 3,000 yards. It passes right by a large shade tree located approximately 200 yards east and 300 yards north of the town square. There is a stretch of the road, between 300 and 1200 yards to the east of town, which currently has no houses. This stretch of road is where you would like to locate your house. Building restrictions require all houses sit parallel to the road. All water supplies are linked to town wells and the closest well to this part of the road is 500 yards east and 1200 yards north of the town square.

1. How far from the well would it be if the house was located on the road 300 yards east of town? 500 yards east of town? 1,000 yards east of town? 1,200 yards east of town? (For the sake of calculations, do not consider how far the house is from the road, just use the road to make calculations)

2. The cost of the piping leading from the well to the house is a major concern. Where should you locate your house in order to have the shortest distance to the well? Justify your answer mathematically.

3. If the cost of laying pipes is $22.5 per linear yard, how much will it cost to connect your house to the well?

4. The builder of your house is impressed by your calculations and wants to use the same method for placing other houses. Describe the method you used. Would you want him to place the other houses in the same manner? Why or why not?

5. Write a formula that the builder could use to find the cost of laying pipes to any house along this road. How would you have to change your formula for another road? Be sure to define any variables you use.