Imagine that you were a space explorer and that you discovered a planet. High above in your shuttle, you notice that one of the cities, Euclid, designed the street system to look like a coordinate grid. The Euclideans describe the locations of buildings and other landmarks by giving coordinates. For example, the art museum is located at (6, 1).

**INVESTIGATION 1-1**

**Task 1**

Give the coordinates of each landmark:

a) gas station  

b) animal shelter  

c) stadium  

In the city of Euclid, how does driving distance compare to flying distance?

**Task 2**

Euclid’s chief of police is planning emergency routes. She needs to find the shortest route between landmarks. Help her by:

a) giving precise directions for an emergency car to take (in terms of blocks)

b) finding the total distance in blocks the emergency car would take.

<table>
<thead>
<tr>
<th>Route 1</th>
<th>Route 2</th>
<th>Route 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>The police station to City Hall</td>
<td>The hospital to City Hall</td>
<td>The hospital to the art museum</td>
</tr>
</tbody>
</table>
Task 3

The stadium is at (-2, 3) and the high school is at (1, 8). What is the shortest driving distance (in blocks) between these two locations? Can you figure this out without looking at the grid? Explain.

Task 4

Suppose you know the coordinates of two landmarks in Euclid. How can you determine the shortest driving distance (in blocks) between them?

Task 5

A helicopter can travel directly from one point to another. For each route in task 2, find the approximate distance (in blocks) a helicopter would have to travel to get from the starting location to the ending location.

ROUTE 1

ROUTE 2

ROUTE 3

Will a direct helicopter route between two locations always be shorter than a car route? Explain your reasoning.
APPLICATION 1-1

We will use the same map of Euclid.

1. Give the coordinates of each landmark.
   a) art museum
   
   b) hospital
   
   c) greenhouse

2. What is the shortest driving distance from the animal shelter to the stadium?

3. What is the shortest driving distance from the hospital to the gas station?

4. Suppose you travel by taxi. What are the coordinates of a point halfway from City Hall to the hospital? Is there more than one possibility? Explain how you know.

5. Suppose you traveled by helicopter. What are the coordinates of a point halfway from City Hall to the hospital? Is there more than one possibility? Explain.
APPLICATION 1-1

We will use the same map of Euclid.

6. Imagine that you’d be able to build a middle school in Euclid. It would be located at the intersection of two streets and the school is the same driving distance from the gas station as the hospital is from the greenhouse.

   a) List the coordinates of each place on the map where the school might be located.
      (hint: There are more than two)

   b) Find the flying distance (in blocks) from the gas station to each location you listed in part a).
INVESTIGATION 1-2

The City Council would like to develop parks with geometric shapes. For some of the parks, the council gives the park designers constraints. For example, Descartes Park must have corners at vertices (1, 1) and (4, 2).

Task 1

Define the following:

Rectangle

Square

Parallelogram

Right Triangle

Task 2

Suppose the park is a square. What could the coordinates of the other two vertices be? Give two answers and explain how you know.

Suppose the park is a rectangle that is not a square. What could the coordinates of the other two vertices be? Give two answers and explain how you know.
Suppose the park is a right triangle. What could the coordinates of the other vertex be? Give two answers and explain how you know.

Suppose the park is a parallelogram that is not a rectangle. What could the coordinates of the other two vertices be? Give two answers and explain how you know.
The points (0, 0) and (3, 2) are two vertices of a polygon.

1. Suppose the polygon is a square. What could the other two vertices be?

2. Suppose the polygon is a nonrectangular parallelogram. What could the other two vertices be? Give three different examples
   a) 
   b) 
   c) 

3. Suppose the polygon is a right triangle. What could the other two vertices be? Give two different examples.
   a) 
   b)
INVESTIGATION 1-3

Below are some park designs submitted to the Euclid City Council. To determine costs, the council needs to know the area of each park.

Task 1
Describe how might you find the areas of irregular figures on dot paper?
Task 2

Consider the horizontal or vertical distance between two adjacent dots to be 1 unit.

Find the area of each figure. Then describe the strategies you used.

<table>
<thead>
<tr>
<th></th>
<th>Area:</th>
<th>Strategy used:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
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<td>6</td>
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</tbody>
</table>
## Task 2

Consider the horizontal or vertical distance between two adjacent dots to be 1 unit.

Find the area of each figure. Then describe the strategies you used.

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<thead>
<tr>
<th></th>
<th>Area:</th>
<th>Strategy used:</th>
</tr>
</thead>
<tbody>
<tr>
<td>7.</td>
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<td>8.</td>
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<td>9.</td>
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<tr>
<td>10.</td>
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</tbody>
</table>
Problems Of the Week

Choose a side to work on and complete the problems on that side. If you finish all the problems on that side after you’ve collaborated with your classmates, try the other side.

1) Look at the ordered pairs below. Do not plot the points on a grid to answer the questions.

(2, -3)   (-3, 4)   (-4, 5)   (4, 5)
(-4, 6)  (-5, -5)  (0, -6)  (6, 0)

a. Which point is farthest right? Explain your reasoning.

b. Which point is farthest left? Explain your reasoning.

c. Which point is above the others? Explain your reasoning.

d. Which point is below the others? Explain your reasoning.

2) Below are equations for eight lines.

line 1: \( y = 3x + 5 \)  
line 2: \( y = 0.5x + 3 \)  
line 3: \( y = 10 - 2x \)  
line 4: \( y = 1 - \frac{1}{3}x \)

line 5: \( y = 7 + 3x \)  
line 6: \( y = -2x + 1 \)  
line 7: \( y = 5 + 6x \)  
line 8: \( y = 3x \)

a. Which of the lines are parallel to each other? How do you know?

b. Which of the lines are perpendicular to each other? How do you know?

c. Generalize two statements to explain how two lines are parallel and perpendicular to each other just by looking at their equations.

3) In the figure to the right, a circle is inscribed in a square.

a. Find the area of the circle.

b. Find the area of the shaded region.
Problems Of the Week

Choose a side to work on and complete the problems on that side. If you finish all the problems on that side after you’ve collaborated with your classmates, try the other side.

1) On grid paper, draw several parallelograms (at least 5) with diagonals that are perpendicular to each other. What do you observe about these parallelograms?

2) Find the areas of triangles AST, BST, CST, and DST. How do the areas compare? Why do you think this is true?

3) Below are equations for eight lines.
   line 1: \( y = 3x + 5 \)   line 2: \( y = 0.5x + 3 \)   line 3: \( y = 10 - 2x \)   line 4: \( y = 1 - \frac{1}{3}x \)
   line 5: \( y = 7 + 3x \)   line 6: \( y = -2x + 1 \)   line 7: \( y = 5 + 6x \)   line 8: \( y = 3x \)

   a. Which of the lines are parallel to each other? How do you know?

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