Subways - Lesson 3 - Distance Formula - SD

Introduction
One of the obvious but important things that maps often illustrate is distance. It might only be 7 inches across the page from Los Angeles to New York, but you know that each inch equates to hundreds of miles. Similarly, when you look at subway maps to get around cities, you often want to know distances from one place to another. If you were going to build a subway system for an entire city, and each mile of tunnel and track costs hundreds of thousands of dollars, it would be vital to know distances. And, it would also be helpful to the people of the city to design a map that would minimize their travel distances as much as possible. In this lesson, you will explore the distance formula and think about the lengths of tunnel and track that you designed on your map.

This is the starter map. You will find this map picture in Choreo Graph and use it to create a subway map as the background. (You can also use the subway map that you already designed from Lesson 1.)

One unit on the grid in Choreo Graph = ¼ mile = .25 mile
The Distance Formula
You might have heard that the shortest path between two points is a straight line, and that is exactly what the distance formula finds. The two points are (x, y) coordinates, 

\[(x_1, y_1) \text{ and } (x_2, y_2)\]

the 1’s and 2’s attached to the coordinates to show that there are two points. Here is the formula, and below is pictured an example of how to use the formula.

\[d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}\]

This image shows how the distance formula can be used to find the distance between Jones and Simone.
To do
Let's explore some of the key distances on your map.

For each distance that you find, show your work with the distance formula in the space provided.

<table>
<thead>
<tr>
<th>Looking at your map, which segment appears to be the <strong>least</strong> distance?</th>
<th>Distance between stations (show work here)</th>
</tr>
</thead>
<tbody>
<tr>
<td>From: __________ at ( , )</td>
<td></td>
</tr>
<tr>
<td>To: __________ at ( , )</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Looking at your map, which segment appears to be the <strong>greatest</strong> distance?</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>From: __________ at ( , )</td>
<td></td>
</tr>
<tr>
<td>To: __________ at ( , )</td>
<td></td>
</tr>
</tbody>
</table>

Questions:

1) Using the subways lines that you created on your map, the coordinates from your table in Lesson 1, find the following total distance that a passenger must travel on a train to make the following trips, (show your work using the distance formula):

   a) Armstrong to Fitzgerald

   b) Bird to Coltrane

   c) Simone to the Museum
2) Based on the distances you have calculated, what do you estimate the total distance of subway tracks to be on your entire map? (Show how you arrived at that estimation.)

3) Now that you have found some distances that your citizens will be traveling to get from one point to another, do you notice any aspects your map that could be improved upon? For example, do you see the need for a line that wasn’t there? Or, are there lines that you could leave out?

4) Did you draw a subway line directly from Armstrong to Jones? If not, why not? Wouldn’t that be the most direct route?

5) What is the most difficult or tricky about using the distance formula?
The map you use for this lesson should look something like this map. Choreo Graph provides the coordinates and line segments of your subway lines.