Subways - Lesson 5 - Efficiency - TD

Lesson Overview
Subway passengers are interested in traveling the city safely and quickly. How well do student maps move people around the city? Could distances be reduced? Or, could increasing distances in some cases actually improve efficiency? Could there be ways to create the network of lines so that citizens could get from one point in the city to another in the fastest way possible?

This lesson is meant to be a recap of Lessons 1-4, and a lead-in to Lesson 6 wherein students will be given a budget, and will be asked to create a new map from scratch. They will create a report with data to support their designs.

This is the starter map. Load this file onto student iPads as it is the correct aspect ratio. Students will see the map image in Choreo Graph and then create a subway map with this as the background. (Students can also use the subway map that they already designed from Lesson 1.)

One unit on the grid in Choreo Graph = ¼ mile = .25 mile

Riverville

Armstrong
Holiday
School
Bird
Thelonious
Simone
Miles
Museum
Hospital
Coltrane
Spalding
Jones
Fitzgerald
Introduction

The dictionary definition of **efficiency**:

> The ability to accomplish something with the least waste of time and effort.

For the subway system, we are concerned with, 1) safety, 2) time it takes to travel around the city, but also, 3) the reality of budgets and urban planning.

This lesson will guide students through a series of summative questions about their original subway maps in an effort to help prepare them to make mathematically sound decisions in creating a new map from scratch in Lesson 6.

**Learning Objectives:**

<table>
<thead>
<tr>
<th>Efficiency</th>
<th>Activity: Students will take what they learned from lessons 1-4, and make some changes to their map that will increase efficiency. Minimizing distance and time to travel around the city.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td><strong>Objective</strong>: SWBAT edit and modify their subway maps in order to maximize the efficiency of their system.</td>
</tr>
</tbody>
</table>

**What you need to get started:** Set of iPads with the Choreo Graph app, student sheets

**Time Needed:** 1 Class period

**Collaboration and Group Work**

These lessons are designed for students to work individually, in pairs, or in groups. Each student should do all the work on their own sheets, and the iPad should be shared across group members as equally as possible.

We suggest that groups be no larger than four students. Four or more students in a group will require extra attention to make sure that every group member is contributing equally.

**Lesson Plan**

**Introduction**

By now students have spent a good amount of time with Choreo Graph and the mathematics in their designs. This lesson invites the opportunity to engage less in calculations and more in questioning what all the data actually means.

Some questions to pose:

- Why would cities want to have efficient subway systems in the first place? How does an efficient transportation system help the city at large?
What are some variables in subway systems that we have not taken into account? (Answer: Passenger capacity, costs, and many of the items they will deal with in Lesson 6.)

What else has emerged in your thinking about subways and cities as you have been doing these lessons?

To do
1) Students will follow the worksheet, and will be guided to answer a series of thought-provoking questions about how the math they have been learning can enhance efficiency. The questions are included below.
2) Have students share their answers with each other in small groups, and then report out to the larger class.

Sharing
1) With each lesson, spend some time allowing the students to share their work with the class. In this lesson, students can share ideas they came up with to increase efficiency.
2) You might also invite students to start thinking about the most important aspects to consider when creating a new subway system from scratch.

Wrapup
If necessary, have students label their iPads so they will be able to return to them for the next lessons.

Questions
1) Will minimizing total distance of track be the best way to maximize efficiency for travelers around the city? Why or why not? Use some mathematical reasoning in your answers.

2) How does creating new local stations help to improve efficiency of getting around the city?

3) Adding trains to your system would help to move more people around the city. What is the most number of trains that you would add to each line? Why is that the most?

4) With your added trains, would you have some running on parallel tracks in the opposite direction? If so, why would that help?

5) When it comes to designing and building an entire subway system, what are three examples of very important aspects to consider? And, what are three more examples of important physical parts of the system? (One example for each is given.)
6) As we have seen, efficiency is complex. Describe the things that you would take into account if you were to make a new map, starting from scratch.

The map students use for this lesson should look something like this map. Choreo Graph provides the coordinates and line segments representing the subway lines.