Bus Routes - Teacher's Guide

9 - 12th Grade

For discussion: This is a well known problem studied in the field of graph theory called the traveling salesman problem. There is no known answer, only different heuristics or rules by which to solve the problem.

1. Who found the shortest path? Please send your solution to the LCS Transportation Department.
2. Nearest Neighbor often works well, but for this particular problem, the result is a disaster. In fact if you follow it strictly, you'll just get stuck looping around I,J,H.
3. Could you simply compute the distance of every possible route? How many possible routes are there?
4. Can you think of a better strategy?

Below are some notes to help with the discussion section.

1. If the spirit of competition takes over, give the students more time to try to find a better solution.
2. This is an example of why the solutions to the traveling salesman problem are heuristics and not algorithms. They are indeterminate guesses that don't always work.
3. Even this is a tricky question and requires some rules to be set in place because if you don't prevent backtracking, a single route could be infinitely long. And if you completely prevent backtracking, you won't find the optimum path.
4. There are many others, but most require a computer in order to be executed in any reasonable amount of time. One such example is the Ant Colony System: when ants search for food, they leave a trail of pheromone. Without any need for intelligence, simply relying on large numbers of guesses, the shortest paths to the food sources will contain the most pheromone, as those paths can be traversed the quickest (a 100 ft path will be traversed twice as many times as a 200 ft path in the same amount of time). Send enough ants out to the bus stops and soon you'll have a solution!
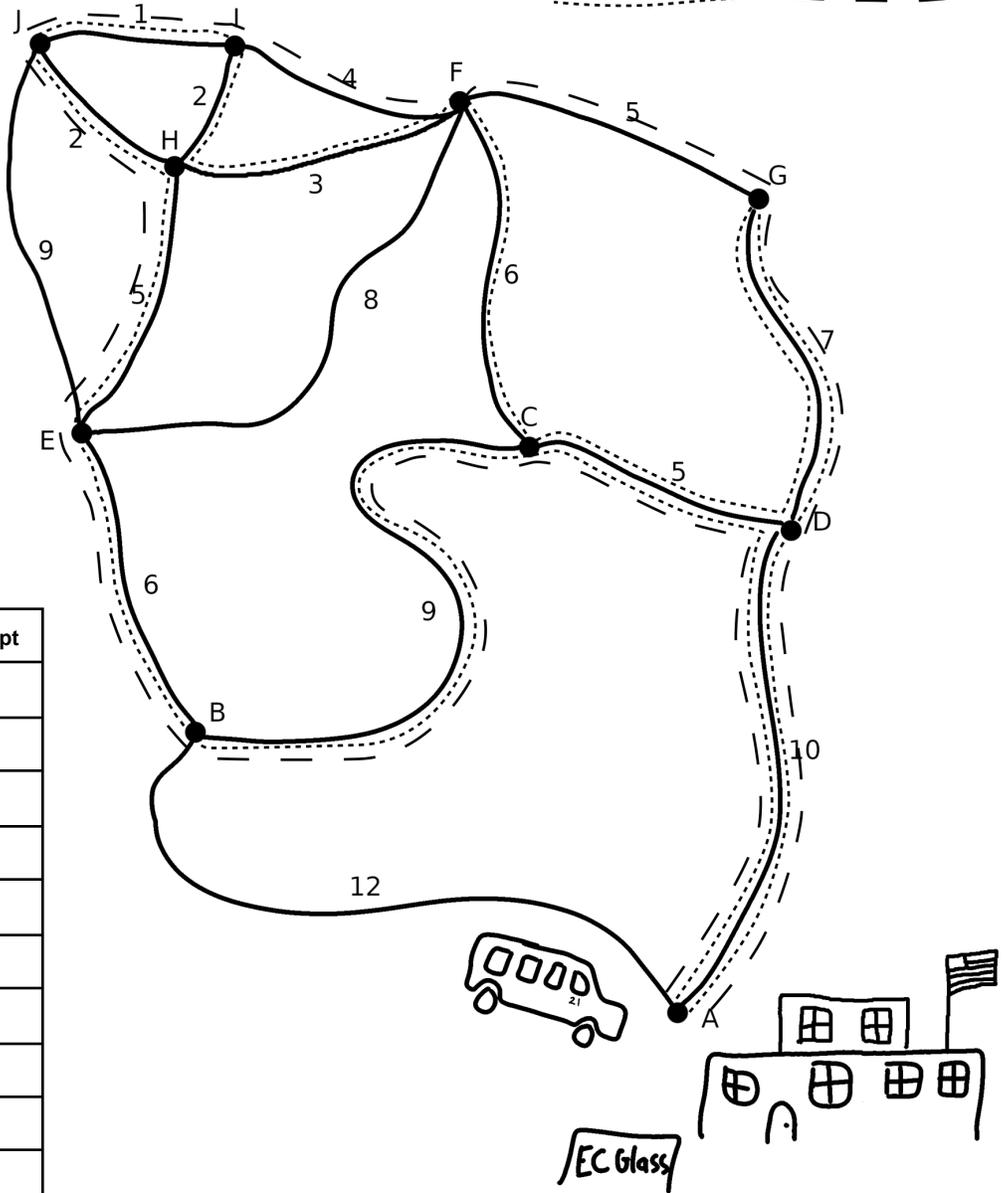
Path	Guess	NN	2-Opt
1	12	10	10
2	6	5	5
3	5	6	9
4	2	3	6
5	1	2	5
6	4	4	2
7	5	2	1
8	5	5	4
9	6	6	5
10	5	9	7
11	10	5	10
12		7	
13		7	
14		10	
Total	61	81	64

EC Glass