

**Networks and Graphs: Spanning Trees****VII.B Student Activity Sheet 7: Minimal Spanning Trees**

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A railroad system connecting five cities is being planned. The goal is to build this system using the least amount of money, while ensuring that each city can be reached by any other city in the system. Based on the distance and terrain, the following chart gives estimates for the cost, in hundreds of thousands of dollars, to build a railroad between any two cities.

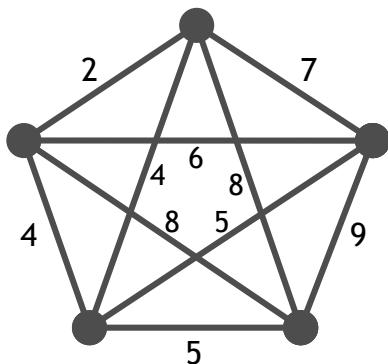
	City A	City B	City C	City D	City E
City A		10	5	4	2
City B			7	9	11
City C				5	10
City D					12

1. Create a graph to model the costs contained in the table.
2. Restate the railroad problem using the terminology associated with graphs (for example, *vertices*, *edges*, *paths*, *cycles*).
3. Construct two different graphs that represent possible railroad networks, and calculate the total cost to build each rail system.
4. What rail system leads to the lowest construction cost?
5. How did you arrive at the most efficient rail system? State your answer in a step-by-step algorithm that someone else could follow.

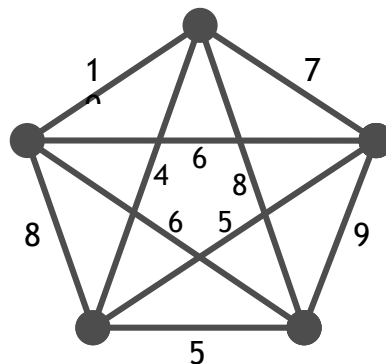
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6. The numbers in the following graphs depict the cost associated with building a railroad between cities represented by vertices. For each graph, test your algorithm. Does it yield the most efficient network? If not, try modifying your algorithm.



Network I



Network II

7. **REFLECTION:** Given any weighted graph (like the ones from this activity), does an efficient network of minimal cost always exist? Why or why not?
8. **EXTENSION:** What other real-world problems might be solved by creating and analyzing graphs with weighted edges? Conduct research to respond to this question, and prepare a short presentation for the class.