Content Map: Networks and Graphs

Teacher Materials: Networks and Graphs Teacher Materials (The Charles A. Dana Center)

CCGPS Unit Standards or Troup County Version (TCV):
- MAMDMA2.
  Students will use a variety of network models to organize data in quantitative situations, make informed decisions, and solve problems
  - a. Solve problems represented by a vertex-edge graph, and find critical paths, Euler paths, and minimal spanning trees
  - b. Construct, analyze, and interpret flow charts to develop an algorithm to describe processes such as quality control procedures
  - c. Investigate the scheduling of projects using PERT
  - d. Consider problems that can be resolved by coloring graphs

- MAMDMA1.
  Students will use vectors and matrices to organize and describe problem situations.
  - a. Represent situations and solve problems using vectors in areas such as transportation, computer graphics, and the physics of force and motion
  - b. Represent geometric transformations and solve problems using matrices in fields such as computer animation.

Prerequisites:
- Constructing and using matrices
- Understand and be able to apply the rules for manipulating the mathematics of matrices
- Understand and apply rules and properties for the coordinate system
- Understand and apply the organization and reading of maps

Unit Length: 22 days
Concept 1: Circuits, Paths, and Graph Structures (MAMDMA2. a-b; MAMDMA1.a-b)

Essential Questions:
- How can students use graphs and the definitions of circuits and paths to study the Königsberg Bridge problem?
- How can students use algorithms to find Euler circuits?
- How can students make conjectures and use theorems to determine whether graphs have Euler or Hamiltonian circuits?
- How can students create graph structures to model two different scenarios?
- How can students make connections between previous graph models?
- How can students complete the entire modeling cycle? (problem statement → creation of mathematical structure → restatement of problem statement → mathematical solution → solution of original problem)

Resources:
- 7.A Student Activity Sheet 1: Euler Circuits and Paths
- 7.A Teacher Activity Sheet 1: Euler Circuits and Paths
- 7.A Student Activity Sheet 2: Dominoes
- 7.A Teacher Activity Sheet 2: Dominoes
- 7.A Student Activity Sheet 3: Weighted Graphs
- 7.A Teacher Activity Sheet 3: Weighted Graphs
- 7.A Student Activity Sheet 4: Hamiltonian Circuits and Paths
- 7.A Teacher Activity Sheet 4: Hamiltonian Circuits and Paths
- 7.A Student Activity Sheet 5: Knight's Tour
- 7.A Teacher Activity Sheet 5: Knight's Tour

Concept 2: Spanning Trees (MAMDMA2 a and b)

Essential Questions:
- How can students represent situations with graphs and then look at ways of determining the spanning trees that solve questions arising from the situation?
- How can students devise, test, and use algorithms for finding spanning trees and minimal spanning trees?

Resources:
- 7.B Student Activity Sheet 6: High-Speed Internet
- 7.B Teacher Activity Sheet 6: High-Speed Internet
- 7.B Student Activity Sheet 7: Minimal Spanning Trees
- 7.B Teacher Activity Sheet 7: Minimal Spanning Trees
- 7.B Student Activity Sheet 8: Kruskal's Algorithm
- 7.B Teacher Activity Sheet 8: Kruskal's Algorithm
**Concept 3: Graph Coloring (MAMDMA2d; MAMDMA1. a-b)**

**Essential Questions:**
- How can students create maps conforming to specific coloring properties?
- How can students create graphs associated with maps?
- How can students create graphs conforming to specific coloring properties?
- How can students use the graph coloring scheduling problem?

**Resources:**
- 7.C Student Activity Sheet 9: Map Coloring
- 7.C Teacher Activity Sheet 9: Map Coloring
- 7.C Student Activity Sheet 10: Coloring Maps and Scheduling
- 7.C Teacher Activity Sheet 10: Coloring Maps and Scheduling

**Concept 4: Program Evaluation and Review Techniques (PERT) Charts (MAMDMA2c)**

**Essential Questions:**
- How can students analyze activity graphs using the Program Evaluation and Review Technique?
- How can students construct activity graphs to incorporate time constraints and interrelationships between and among tasks?
- How can students make conjectures about minimal completion times and the corresponding activity graph?

**Resources:**
- 7.D Student Activity Sheet 11: Activity Graphs
- 7.D Teacher Activity Sheet 11: Activity Graphs
- 7.D Student Activity Sheet 12: Building a Robot
- 7.D Teacher Activity Sheet 12: Building a Robot