

# Coloring Interval Graphs

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## OBJECTIVE, BACKGROUND INFORMATION, & REFERENCES

**The objective of this lesson is to teach the students problem solving methods for scheduling x activities with specific time constraints in as few rooms as possible. Students will develop a method of coloring interval graphs to solve such a problem.**

Standards addressed:

2.1 represent, describe, and analyze patterns and relationships using tables, graphs, verbal rules, and standard algebraic notation;

3.4 formulate hypotheses, draw conclusions, and make convincing arguments based on data analysis;

4.1 construct two- and three-dimensional models using a variety of materials and tools;

**Background Information:** Teachers and students will need basic knowledge of graphs from Graph Theory. For example, they will need to know the definition of a vertex and edge.

**References:** Mike Ferrara and Breeann Tonnsen

## VOCABULARY, MATERIALS, PREPARATION, SAFETY

### Vocabulary:

Vertex, edge, adjacency, interval graph, graph coloring

### Materials Required:

Worksheets, colored pencils, and a white board

### Preparation:

The students will need to be grouped appropriately, and students will need to have colored pencils and the handouts.

### Safety:

There are no safety concerns for this lesson.

## 5 E'S

### Describe how each of the 5 E's will be accomplished:

#### Engage:

Students will be told that we need help organizing some after school activities for Lakewood High School.

#### Explore:

Students will be given a list of activities with time requirements for each (for example: Art club is from 3:30 to 4:30). They will be asked to determine the minimum number of rooms needed for the activities. After a few minutes, we will discuss their findings. Then they will be given a table that has time slots across the top and the activities listed down the side. They color the cells of the table that represent the time requirements for each activity. On the bottom of the worksheet with the table there will be leading questions that ask them to develop a method for determining the minimum number of rooms needed the activities.

#### Explain:

After the above task is complete, I will ask the students of their findings. After a discussion, I will ask them if there would be a way to solve this problem using Graph Theory. The students in my class are familiar with the basics of Graph Theory and they will know of vertices and edges. We will discuss representing each activity with a vertex and having an

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edge between vertices (activities) that run at the same time. We will then discuss how to use the graph to tell us the number of rooms needed. I will suggest using a different color for each room. Then vertices that are adjacent cannot have the same color.

**Elaborate:**

After explaining the use of Graph Theory to solve the problem, I will give them a new list of activities with time requirements. They will need to construct the graph that represents the activities and try to color the graph with as few colors as possible. Then they will need to answer some questions about their graph. If students get done early, I will have some extension questions ready to ask them. For example, I will give them a cycle of length 4 and ask if this could represent four activities with time constraints.

**Evaluate:**

Student will hand in their final graph with the proper coloring and the questions answered. Completion of the task will be assessed, and a score will be put in the “participates in learning” category of the standards based grading.

## PEER REVIEW COMMENTS

Activities:

Art Club:	3:30 – 4:00
Bank Club:	3:00 – 4:30
Ceramics Club:	4:30 – 5:30
Dance Club:	3:00 - 3:30
Electronics Club:	3:30 – 5:00
French Club:	4:30 – 5:00

1. Above is a list of activities for Really Small High School. This high school does not have many rooms. What is the least number of rooms needed to schedule all the activities above so that no two activities happen in the same room at the same time. Assume all the clubs can happen in any room.
2. How do you know your answer to number 1 is the LEAST number of rooms that are needed?
3. How would you figure out the least number of rooms if were a conference and there were 100 activities?

4. Color in the table with your room assignments using a different color for each room.

Activities	3:00-3:30	3:30-4:00	4:00-4:30	4:30-5:00	5:00-5:30

5. How can you tell how many rooms you need using the table?
6. Why might the table be advantageous for scheduling? Why might it be disadvantageous?
7. Draw a graph (vertices and edges) below that represents the scheduling problem. What do your vertices represent? What does an edge represent?

8. How can you tell the minimum number of room using the graph?

9. Why might a graph be advantageous for solving this problem?

10. Draw a graph representing this scheduling problem below. Color it and determine the minimum number of rooms needed for the activities:

A: 12:30-3:00, B: 12:45-3:00, C: 12:00-1:00, D: 2:45-6:00, E: 2:15-4:00, F: 4:45-5:15,  
G: 2:00-4:45, H: 4:30-5:45, I: 5:15-6:30, J: 5:30-7:00