2021 MidMCM
Problem C: Dog Park
Note: Only teams with all members younger than 14½ years old may choose Problem C

Dog parks are becoming increasingly popular in the United States and Canada. The city of Calgary in Alberta, Canada has 10 dog parks for a city of 1.3 million residents, and the city of Boise in Idaho, US has 6.3 dog parks per 100,000 residents!

Considering the benefits they provide to dogs, their owners, and communities, the growth in demand for dog parks is not surprising. A dog park is typically a fenced-in outdoor area where people and their dogs can play together. Dog parks allow dogs to roam, exercise, and play off-leash in a safe and controlled environment. It's like a playground for dogs. Moreover, dog owners are free to socialize while their dogs are playing. This can help new residents establish community connections and allows existing neighbors to stay connected.

Much like playgrounds, dog parks come in many shapes and sizes depending on the space and money available. With enough space comes the option to have separate spaces for large and small dogs. Some owners prefer this separation, while others prefer to have dogs of all sizes play together. Some dog parks have lighting, while others only operate during daylight hours. Basic dog parks may have little more than a fenced in open space, while other more elaborate dog parks may have a wide variety of amenities and dog play equipment.

The Town of Middleville Director of Parks & Recreation has asked your team to develop a plan to build the Middleville Dog Park at the site shown in **Figure 1**. The Director provided the following guidance:

1. You may locate the dog park anywhere within the area outlined in blue in Figure 1.
2. The dog park may be up to 1-acre (43,560 square feet) in total size.
3. You must keep the existing skateboard park in its current location.

Figure 1: Area for Location of Dog Park

1. Planning Your Dog Park

a. The necessary features of a safe dog park are fencing, a water supply, and trash cans. There are many other features that you might want to include in your dog park. Make a list of all the features you want to consider for your dog park.

b. Now think about the decisions you must make to plan and design your dog park. A few of your questions might be:

- What shape and how big will the dog park be?
- Where in the available area (Figure 1) will you locate your dog park?
- What materials will you need to build the park?
- How much will it cost to build and ***maintain*** the dog park?

Make a list of questions you need to ask or decisions you need to make prior to designing your dog park.

c. Describe your dog park. To do this you will need to decide what features you will include, answer your questions, and make necessary decisions (from your work in Parts 1.a. and 1.b.).

2. Designing Your Dog Park

a. Make a ***scale drawing*** of your dog park that includes all the features you decide to include. Label your drawing with measurements and be sure to note your scale. You can hand-draw your dog park or use technology to do so.

b. Builders often use a ***Bill-Of-Materials (BOM)*** to list the materials and items needed for a project, along with quantities and costs. An example of a BOM with a sample entry is shown in **Table 1**.

Bill-Of-Materials				
Item Number	**Description and Size**	**Amount Needed**	**Cost per Item**	**Total Cost**
1.	Fence Gate, Chain-Link, 5-ft tall × 4.5-ft wide	2	$100	$200

Table 1: Sample Entry for Bill-Of-Materials (BOM)

Use your scale drawing to create a BOM for your dog park project.

c. In addition to the cost of the materials and items shown in your BOM, list and describe any other expenses necessary to build and maintain your dog park.

d. Sometimes after developing your plan, you need to make some adjustments. What if Middleville decided to provide more or less space for the dog park than you planned? What if they provided more or less money than you decided you needed to build the park? Rather than starting over, how could you adjust your existing dog park plan? Write a paragraph about how you could ***generalize*** your dog park plan so that it is ***scalable.***

3. Sharing your dog park plan

Write a one-page letter to the Middleville Director of Parks & Recreation describing your dog park and its features. Address the scalability of your dog park.

Your MidMCM PDF solution document should include the following:

- One-page Summary Sheet.
- Table of Contents.
- Your complete solution to the problem and requirements.
- One-page letter to the Middleville Director of Parks & Recreation.
- References List (for example, any websites you used to gather information).

There is no specific required page length for a complete MidMCM submission. You may use up to 25 total pages for all your solution work and any additional information you want to include (for example: drawings, diagrams, calculations, tables). Partial solutions are accepted.

Glossary

Assumption: a hypothesis or educated guess that takes the place of an unknown piece of information.

Bill-Of-Materials (BOM): a complete list of all required parts, items, raw materials, etc. needed to complete a given project, along with their costs.

Generalize: make something less specific.

Maintain: keep clean and safe over time.

Scalable: the ability to change something in size or scale (for example, make larger or smaller).

Scale Drawing: a drawing of a real object that has been made smaller or larger proportionally. The proportion used in the drawing is called the scale ratio.

Guidance for our First Annual MidMCM.

As this is the first year of MidMCM, COMAP does not have example papers online. Therefore, we provide the following general guidance about submission organization.

Solutions must be in PDF format and submitted in one PDF document. However, this does not preclude MidMCM teams from doing mathematics, graphs, tables, sketches, etc. by hand and including pictures of their work in the single PDF document submission. As students move to high school and the HiMCM, we expect that submissions will be typed. For the MidMCM, advisors may assist students in putting their solution components into one PDF format file for submission.

As with HiMCM, there is a 25-page limit for the submission document. This does not mean your solution must be 25 pages. All portions of your submission (text, graphs, tables, charts, pictures, etc.) must be within **one** PDF document that is 25 pages or less. Partial solutions are accepted.

In general, a complete solution submission is organized as follows:

Executive Summary – Write this summary after you have done all of your work. This one-page summary is Page #1 of your solution document. It provides an overview of your work and includes actual results.

Table of Contents – List the major items in your solution document to show the organization of your paper.

Introduction and Restatement of the Problem – Introduce the problem. Restate the problem and requirements in your own words.

Assumptions with Justifications – State any assumptions you made to simplify and solve the problem and state why you made those assumptions. For example:

Assumption: Our dog park fence will be 5 feet tall.

Justification: After researching dog parks online, we found most dog parks had fences between 4 feet and 6 feet tall. We chose to use 5 feet tall.

Variable Definitions – Define any variables you use in your work, drawing, and solution. For example: A = the enclosed area of the dog park measured in square feet.

Presentation of Model and Solution – Ensure you address all requirements and describe what you are doing to solve the problem. Show and explain all your work. Use representations that help you tell the reader how you solved the problem (for example: equations, tables, graphs, pictures, etc.).

Analysis of Your Work – Address any strengths (good points) and limitations (weaknesses) of your solution.

Concluding Paragraph – End your solution paper with a final concluding paragraph that summarizes your results and/or makes recommendations for future work.

Reference List – List any sources that you used to solve the problem (for example, website pages, newspaper or magazine articles, etc.).