Student Handout: Solving the Padlock Problem

Overview

In this lesson, you will learn how to solve a padlock problem using combination generation and optimization. Farmer John wants to find the best word for his lock that maximizes valid word combinations by rotating each disc of letters.

Key Terms

1. **Fixed Rows**: Rows that remain the same on the lock, like "BELLA" and "LOVES."
2. **Flexible Row**: The row where you choose a new word to maximize combinations.
3. **Combination Generation**: The process of rotating each letter disc to create new word possibilities.
4. **Valid Word Check**: Checking whether a generated word exists in a predefined list of valid words.

Problem Summary

Farmer John's padlock has three rows:

1. Fixed Row 1: **BELLA**
2. Fixed Row 2: **LOVES**
3. Flexible Row 3: **Your Choice**

Your goal is to choose the third word that allows for the highest number of valid word combinations when each letter disc is rotated.

Activity 1: Understanding the Concepts

1. **Define**:
    - What is meant by a "combination" in this problem?
    - Why is it important to check combinations against a list of valid words?
2. **Think**:
    - How would rotating each letter in the flexible row change the possible words on the lock?
3. **Discuss** (in pairs or small groups):
    - Why might some words work better than others for the flexible row?

Activity 2: Practice with Combinations

1. **Choose** a third word for the flexible row. (For example: **SHEDS**)
2. **Generate Combinations**:
    - Rotate each letter disc to create possible five-letter words.
3. **Check Validity**:
    - Write down any valid words you generate that match words in the valid words list.

Challenge Question

- **What characteristics** do you think make a word good for the flexible row?
- **Try another word** as the third row. Which of your chosen words created more valid combinations?

Reflection

- How does this exercise help you understand the importance of combination generation?
- Where else might we see this concept applied in real life?

Extension (Optional)

Explore the additional challenges:

- **Top N Words**: Try finding the top 2-3 words that create the most valid combinations.
- **Fourth Row**: How would adding another row to the lock change your strategy?