Bagels, Pico, Fermi

Objectives

In this number game, students work as a class to figure out a three-digit mystery number. Students use logic and the process of elimination to find the answer. It is a great time filler when there are 10 minutes left in class, and once students learn the rules, they can lead the exercise themselves.

Procedure

The teacher (or student leader) thinks of a three-digit number. Do not start the number with a zero (012 is no good, though 102 is fine), and do not use the same digit twice (122 and 212 are both unacceptable). The first few times you play, we suggest you write the number down. When students start guessing, it's easy to forget your number!

Prepare the board by writing the digits **0 1 2 3 4 5 6 7 8 9** and then, below that, three blank spaces. When students eliminate a particular digit, you can cross it off the list. When students think they are certain of a digit, you can write it in the appropriate blank space.

Students now try to guess the number. We only call on students who raise their hands and ignore all other guesses. Call on a student and write his or her number on the board. If the mystery number were **567**, here is how the game might progress:

- If a student guess has **no correct digits**, the teacher responds with the word **Bagels**, and writes the letter **B** next to the guess. Those digits may now be crossed off the list because they have been eliminated.

  guess: 123   response: B

- If a student guess has **one or more correct digits**, but **none is in the correct position**, write one letter **P** (for **Pico**) for each correct digit.

  guess: 125   response: P   (The 5 is correct, but in the wrong place.)
  guess: 175   response: PP   (5 and 7 are both correct, but in the wrong places.)

- If a student has **one or more correct digits**, and they are in the **correct places**, write one letter **F** (for **Fermi**) for each digit.

  guess: 543   response: F   (The 5 is correct and in the correct place.)
  guess: 597   response: FF   (5 and 7 are both correct and in the correct places.)

- Finally, if a **digit is correct but in the wrong place** and **another is correct and in the correct place**, write a **P** and an **F** as appropriate. We always list the **P**s first, so as not to give away too much information.

  guess: 357   response: PF   (P for the 5. F for the 7.)
  guess: 573   response: PF   (P for the 7. F for the 5. List P first.)
  guess: 576   response: PPF   (PP for the 6 and 7. F for the 5. List Ps first.)

- When a student guesses the entire mystery number correctly with the digits in the correct order, that's a Fermi Fermi Fermi, **FFF**!

  guess: 567   response: FFF

The above rules may seem complicated, but after a few rounds, it will all seem quite simple. Also, after a few rounds led by the teacher, the student who gets the correct answer may lead the next game, though we suggest that the teacher help out at first.

Here is a sample game with student guesses followed by teacher responses. The mystery number is **684**.

Guess	Response	Explanation
456	**PP**	4 and 6 are correct but in the wrong places.
123	**B**	No correct digits. 1, 2, and 3 are eliminated.
678	**PF**	P (8) listed first, then F (6), but students can't know for sure.
687	**FF**	Students still can't be sure which ones are the Fermis.
683	**FF**	6 and 8 must be correct since 3 was eliminated earlier (123 was B).
685	**FF**	Good guess since 456 was PP.
684	**FFF**	Got it!

Here is another sample. The mystery number is **305**.

Guess	Response	Explanation
789	**B**	No correct digits.
123	**P**	3 is correct but in the wrong place.
321	**F**	Alert students might realize that 2 has been eliminated (123 was P) and that either 3 or 1 could be correct.
345	**FF**	Is the 3 correct? Or are the 4 and 5 correct? Too soon to tell.
389	**F**	The 3 is correct since 8 and 9 have been eliminated (789 was B).
749	**B**	4 is eliminated. 5 must have been the other Fermi in 345.
365	**FF**	6 is eliminated.

The Names

We don't know the official origin of the name of this game. Bagels are shaped like zeros and indicate that there are no correct digits. Pico (peek-oh), from the Spanish meaning 'beak' or 'peak,' is used in science as a prefix meaning one-trillionth. For example, 1 picometer = 1 trillionth of a meter. Enrico Fermi (fair-mee), 1901-1954, was an Italian-born atomic physicist who later moved to the United States. He won the Nobel Prize in 1938.

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