EXPLORATIONS

Activity 10

Personal License Plates

Teacher Notes

Concept

- Counting Principle
- Exponential Notation

Skill

- Writing rules for calculations involving the counting (principle calculating total number of possibilities from a set of rules)

Applicable Calculator Functions

- [^], [EE]

Materials

- Student Activity Sheets (page 98)
- Straight edge, colored pencils, markers or crayons, construction paper
- TI-30X IIS/TI-34 II calculator

Objective

- Students will create personal license plates following rules they choose and calculate the total number of plates possible using those rules

Prerequisites

Students should have experience using the counting principle, including some situations in which repeats are allowed and others in which they are not.

Examples:

- *How many different three-letter monograms are there? (26 x 26 x 26)*
- *How many ways are there to have a three-digit code if no repeats are allowed? (10 x 9 x 8). It would be helpful, but not necessary, if students had prior experience using the [^] and [EE] keys.*

Problem

Design a license plate following rules you choose. On a separate sheet of paper, write the rules you used, show how to calculate the total number of plates possible using your rules, and provide that total.

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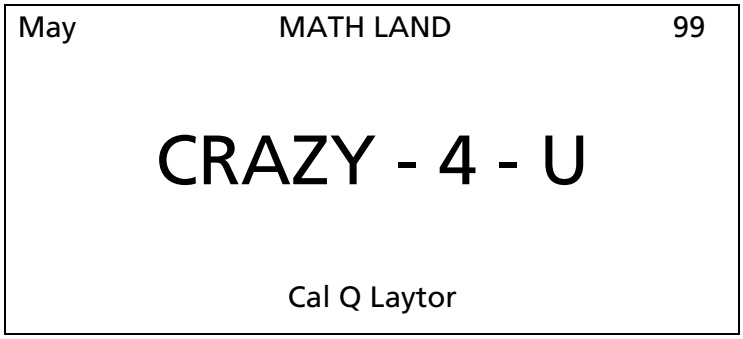
Activity

You will probably want to show one or two samples of this assignment to motivate students.

Example:

1. There are seven spaces in my plate.
2. The first space must be either the letter A, B, or C.
3. The next four spaces may be any letter and may not repeat.
4. The next space may be any digit except 0.
5. The last space must be a vowel.
6. 3 x 25 x 24 x 23 x 22 x 9 x 5 = 40,986,000 possible plates.

Sample license plate for this rule:



Before students start to work, you may want to remind them how to use the ^ and [EE] keys, as these keys might be helpful in calculating the number of possibilities for plates following their rules. You should also review the term "digit" as opposed to "number" or "numeral" and provide any needed review with counting situations (perhaps some that allow repeats and some that do not).

Students should first work alone to create a rough draft of their design and rules. Then they should work with a partner to check each other's rules and calculations for clarity and accuracy. Finally, they may need to work in groups of four to try each other's rules. In this way, students can find most errors in each other's rules or work and get additional practice with the counting principle. Only after having his/her work checked by other students should a student prepare the final version.

Wrap-Up

Show students an actual license plate from your state/country. Have students work in pairs to create a possible set of rules that the state/country motor vehicles division might have.

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Assessment

The completed plates, rules, and calculations serve as an assessment tool. It is also appropriate to give a similar follow-up problem for students to solve individually.

Example:

For passenger cars in the state of Connecticut, there are three digits followed by three letters. Repeats are allowed, but the values 000 through 099 are not used. How many license plates are possible using these rules? ($9 \times 10^2 \times 26^3$ or 15,818,400)

Extensions

- Have students gather data from the Internet and/or the agency that issues license plates and then answer the following questions:
  - Using the rules you made up for your license plate, would there be enough possible plates so that everyone in your state/country could have one?
  - If not, can you change one of your rules to make this possible?
  - Find the actual rules for passenger cars in your state/country. How many license plates are possible using those rules? Based on the population growth rate in your state/country, when might the state/country run out of possible license plates and need to change the rules?
- Have students change one or more of their rules to incorporate knowledge of a particular math concept.

  Example:

  The last two digits must be a two-digit prime number.

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Student Activity

Name _____

Date _____

Activity 10

Personal License Plates

Objective: *You will create personal license plates following rules you choose and calculate the total number of plates possible using those rules.*

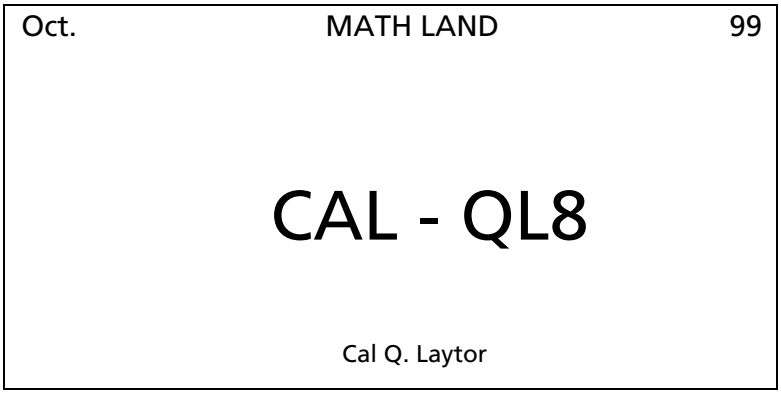
Problem: *Design a license plate following rules you choose. On a separate sheet of paper, write the rules you used, show how to calculate the total number of plates possible using your rules, and provide that total.*

Example:

- There are six spaces in my plate.
- The first three spaces may be any letter and may repeat.
- The next two spaces may be any letter but may not repeat.
- The next space may be any digit except 0.

Calculations: 26 x 26 x 26 x 26 x 25 x 9 = 102,819,600 possible plates

Sample license plate for this rule:



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1. Formulate a set of rules for designing a personal license plate.

2. Draw a sample license plate, using your rules.

3. Show the calculations needed to find the number of possible plates that could be generated using your rules.

4. Exchange papers with a partner and check each other's rules, calculations, and sample design.
5. Make any needed changes to your rules and calculations.
6. Using construction paper, colored pencils, markers, or crayons, draw your sample design for a personal license plate that follows your rules of design.
7. Put your name in the lower right corner on the front of your license plate.
8. On a separate sheet, write your rules and list of calculations for the total number of plates possible.

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Personal License Plates
Keystrokes for the TI-34 II

Example: 12^4

PRESS	DISPLAY
12	12
[^] 4 [ENTER]	12^4 20736

Example: 10^3

10	10
[^] 3 [ENTER]	10^3 1000

or

[EE]	**E**
3	**E**3
[ENTER]	**E**3 1000

Example: $26 \times 26 \times 26 \times 26 \times 25 \times 9$ or $(26^4 \times 25 \times 9)$

26 [^] 4	26^4
[×] 25 [×] 9 [ENTER]	26^4 X 25 X 9 102819600

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Personal License Plates
Keystrokes for the TI-30X IIS

Example: 12^4

PRESS	DISPLAY
12	12
[^] 4 [ENTER]	12^4 20736

Example: 10^3

10	10
[^] 3 [ENTER]	10^3 1000

or

[2nd] [EE]	**E**
3	**E**3
[ENTER]	**E**3 1000

Example: $26 \times 26 \times 26 \times 26 \times 25 \times 9$ or $(26^4 \times 25 \times 9)$

26 [^] 4	26^4
[×] 25 [×] 9 [ENTER]	26^4*25*9 102819600

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