Pre 1.3 Powers and Place Value

Lesson Summary: This activity teaches students about powers of 10 using calculators to observe patterns. Students first relate powers of 10 to scientific notation and standard notation. Then they play a game which requires use of place value and scientific notation.
Utah Core Indicators: Pre-Algebra Content Standards 1.25, 2.1 Process Standards 1-5
Broad Understanding:

- Scientific Notation is used to facilitate manipulation of very large and very small numbers. This manipulation is important in many fields of study and work.

Essential Questions:

- Who uses numbers with exponents?
- What happens when an exponent gets larger, smaller, or is negative?
- How are exponential powers related to place value?

Knowledge and Skills:

- Problem solving
- Patterns
- Place value, Multiplying by 10, 100, 1000, etc.
- Basic calculator use

Assessment Evidence:

- Evaluate student worksheets for completion and quality.
- For problem solving activities involving scientific notation, access activity 0.1 in the Algebra Anytime module.
- Use a traditional test.
- Students write responses to the Essential Questions. Evaluate using the understanding rubric found under assessment on the Teacher Info link.

Pre 1.3 Learning Plan

Materials: Calculators
Time: 2-4 days
Lesson Type: Student Activity
Directions:
Have students do the worksheets. Then have a large group discussion.
Discourse Suggestions:

- What are a base, exponent, and power?
- What changes are you seeing in your answer as the exponent changes?
- Why do you get the same answer to $3 * 10^2$ and $10^2 * 3$?
- Can you multiply power numbers together?
- What is a Keystroke Sequence?

For practice using exponents and scientific notation, turn to other worksheets or textbook pages.

Discuss the Essential Questions.

Extension: "Space Invader Game" simulation**.** Students might make up their own "Space Invader Game" number.

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Name _____

Part 1 Use your calculator to fill in the blanks and change these Scientific Notation numbers into Standard numbers or Standard numbers into Scientific Notation.

	Scientific Notation		**Standard Number**
	Calculator Notation	Exponent Notation	Standard Number
example			
example			
1.	10^0		
2.	10^1		
3.	10^2		
4.			1000
5.			10000
6.	2 * 10^0		
7.	2 * 10^1		
8.	2 * 10^2		
9.			2000
10.	4 * 10^3		
11.			80000
12.	6 * 10^5		
13.	10^5 * 6		
14.			20
15.	10^0 * 12		
16.	10^0 * 65		
17.			700
18.	10^3 + 2		
19.	10^3 + 8		
20.			2
21.			15
22.			150
23.			1500
24.	10^8 * 86		
25.			4000000000

26. What change do you see when the exponent changes to:
    a larger number? _____

    a smaller number? _____

27. 10^2= _____ and 10^2 * 4 = _____

28. What change happens when you multiply the power number by a 4?

    _____

29. What would you get if you multiplied the same power number by 7?

    _____

30. What number would you have if you added 10^2 + 45? _____

31. What do you now know about place value and power numbers?

Part 2 Complete the tables below without the calculator. Use the pattern to help you.

10000.	_____	____		64	_____
1000.	1 thousand	____		32	_____
100.	_____	____		16	_____
10.	_____	10^1		8	_____
1.	_____	____		4	2^2
.1	_____	____		2	_____
.01	_____	____		____	_____
.0001	_____	____		____	_____

1) Explain the patterns you found in the table above.

2) Explain your thinking about negative exponents?

SPACE INVADERS GAME

Your job is to protect planet Earth. The digits of the following number are invading: **63418275.** You must shoot the digits in ascending order. That is, you must first eliminate the 1, then the 2, then the 3, etc. For each digit, record the keystroke sequence which includes the $\mathbf{10^n}$ (10^n). If not, reenter the previous display and try again.

Game 1: The invading number is 63,418,275.

Digit to Eliminate	Keystroke Sequence	Resulting Number in Display
start		63418275
1	63,418,275 – 1 * 10 ^ 4	63408275
2		63408075
3		60408075
4		60008075
5		60008070
6		8070
7		8000
8		0

Game 2: The invading number is 92,574,836.

Digit to Eliminate	Keystroke Sequence	Resulting Number in Display
start	-	92574836
2		
3		
4		
5		
6		
7		
8		
9		0

Game 3: **The invading number is 5,478,932.16.**

Digit to Eliminate	Keystroke Sequence	Resulting Number in Display
start	-	5478932.16
1		5478932.06
2		5478930.06
3		5478900.06
4		5078900.06
5		78900.06
6		78900
7		8900
8		900
9		0

Game 4: **The invading number is 52,197.3846.**

Digit to Eliminate	Keystroke Sequence	Resulting Number in Display
start	-	52197.3846
1		
2		
3		
4		
5		
6		
7		
8		
9		0

SUPER MISSILE SPACE INVADERS

Protect the Earth with fewer shots. Remove all the digits in order with only one shot for each set of digits. Record you keystroke sequence. Reenter if necessary.

Example Game: The invading number is 33424311.

Digit to Eliminate	Keystroke Sequence	Resulting Number in Display
Start	-	33424311
1's	-11 x 10^0	33424300
2's	-2 x 10^4	33404300
3's	-330003 x 10^2	404000
4's	-404 x 10^3	0

Game 1: The invading number is 12,423,433.

Digit to Eliminate	Keystroke Sequence	Resulting Number in Display
start	-	12423433
1's		
2's		
3's		
4's		0

Game 2: The invading number is 86,637,475.

Digit to Eliminate	Keystroke Sequence	Resulting Number in Display
start	-	86637475
3's		
4's		
5's		
6's		
7's		
8's		0