**Key Words**

**Scientific Notation:**
The scientific notation is the representation of a number as the product of a finite decimal, $d$, and a power of 10. The decimal $d$ must be greater than or equal to 1 and less than 10. The exponent of the power of 10 must be an integer. For example, the scientific notation for $192.7$ is $1.927 \times 10^2$. An example of a number that is not written in scientific notation is $0.234567 \times 10^3$ because $0.234567$ is not greater than or equal to 1 and less than 10.

**Order of Magnitude:**
The order of magnitude of a finite decimal is the exponent in the power of 10 when that decimal is expressed in scientific notation. For example, the order of magnitude of $192.7$ is 2 because when $192.7$ is expressed in scientific notation as $1.927 \times 10^2$, 2 is the exponent of $10^2$.

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**Integer Exponents and Scientific Notation**

In this 13-lesson module, students expand their knowledge of operations on numbers to include integer exponents and use this knowledge to transform expressions. Students will also make conjectures about how zero and negative exponents of a number should be defined and prove the properties of integer exponents. Students will also make sense out of very large and very small numbers and will use the number line to guide them in determining the relationship between numbers.

In general, if $x$ is any number and $m$, $n$ are positive integers, then

$$x^m \cdot x^n = x^{m+n}$$

In general, if $x$ is nonzero and $m$, $n$ are positive integers,

$$\frac{x^m}{x^n} = x^{m-n}, \text{ if } m > n.$$
Sprinting Towards Fluency!
Sprints help develop fluency, build excitement towards mathematics, and encourage students to do their personal best! They are not necessarily a competition among classmates, but a quest to improve upon a student’s previous time, ultimately helping them achieve the desired fluency when they are working with numbers as well as provide a feeling of achievement when their second sprint shows improvement.

During the Sprint activity below, your role as the parent will be the same as the role of the teacher when the class is completing this activity. You will keep track of the time as well as be an exciting and encouraging coach for your child. You will give your child the following: a copy of Sprint A and Sprint B. You can make a copy of this newsletter or use the original and fold the newsletter in half so your child only sees one Sprint at a time. You can use a stopwatch to record the time. For these modified sprints, please give your child 15 seconds to complete the 11 problems. The answers for both Sprints are provided at the bottom of the newsletter.

Have fun!

The Sprints!
Directions: Rewrite each item as an equivalent expression in exponential notation. All letters denote numbers.

**Sprint A**

1. $2^2 \cdot 2^3$
2. $2^2 \cdot 2^4$
3. $2^2 \cdot 2^5$
4. $99^5 \cdot 99^2$
5. $99^6 \cdot 99^3$
6. $99^7 \cdot 99^4$
7. $r^8 \cdot r^2$
8. $s^8 \cdot s^2$
9. $x^3 \cdot x^2$
10. $5^4 \cdot 125$
11. $8 \cdot 2^9$

**Sprint B**

1. $5^2 \cdot 5^3$
2. $5^2 \cdot 5^4$
3. $5^2 \cdot 5^5$
4. $11^{12} \cdot 11^2$
5. $11^{12} \cdot 11^4$
6. $11^{12} \cdot 11^6$
7. $x^7 \cdot x^3$
8. $y^7 \cdot y^3$
9. $2^9 \cdot z^8$
10. $2^{11} \cdot 4$
11. $2^{11} \cdot 16$

Sample Problem from the Module

**Compare $2.01 \times 10^{15}$ and $2.8 \times 10^{13}$. Which number is larger?**

Sample Solution:

$2.01 \times 10^{15} = 2.01 \times 10^2 \times 10^{13} = 201 \times 10^{13}$

Since $201 > 2.8$, we have $201 \times 10^{13} > 2.8 \times 10^{13}$, and since $201 \times 10^{13} = 2.01 \times 10^{15}$, we conclude $2.01 \times 10^{13} > 2.8 \times 10^{13}$.  

Answers to the Sprints.

<table>
<thead>
<tr>
<th>Sprint A</th>
<th>Sprint B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. $2^4$</td>
<td>1. $5^5$</td>
</tr>
<tr>
<td>2. $2^6$</td>
<td>2. $5^6$</td>
</tr>
<tr>
<td>3. $2^7$</td>
<td>3. $5^7$</td>
</tr>
<tr>
<td>4. $99^5$</td>
<td>4. $11^{14}$</td>
</tr>
<tr>
<td>5. $99^6$</td>
<td>5. $11^{15}$</td>
</tr>
<tr>
<td>6. $99^7$</td>
<td>6. $11^{16}$</td>
</tr>
<tr>
<td>7. $r^{10}$</td>
<td>7. $x^{10}$</td>
</tr>
<tr>
<td>8. $s^{10}$</td>
<td>8. $y^{10}$</td>
</tr>
<tr>
<td>9. $x^{10}$</td>
<td>9. $z^{10}$</td>
</tr>
<tr>
<td>10. $5^{11}$</td>
<td>10. $2^{13}$</td>
</tr>
<tr>
<td>11. $2^{14}$</td>
<td>11. $2^{15}$</td>
</tr>
</tbody>
</table>

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