Collaborative Sculpture Project Guidelines

Learning Objective: I can make personal connections and find creative solutions by working collaboratively on a sculpture.

- You need to use all the wiffle balls in your bag, but you do not need to use all of the wires.
- Your sculpture needs to fit on your table top.
- Stand up, stretch your legs and move around the table!
- Considering the benefits and limitations of the art materials provided, explore different ways you could use the wire to connect the wiffle balls.
- Your group may be provided with additional materials (as time allows).

Here is what we will be looking for as you work:

	Check +	Check	Check -
Construction	The sculpture shows considerable attention to construction. All items are carefully and securely attached and personalized details added.	The sculpture is adequately constructed. Items are attached somewhat securely.	The sculpture was constructed sloppily. Pieces look loose and thrown together without care.
Creativity	The group shows an exceptional degree of creativity in their creation and/or display.	The group's ideas were typical rather than creative.	The group did not make or customize any part of their sculpture.
Working Collaboratively	All group members participated actively in the sculpture project.	Most group members participated actively in the sculpture project.	The sculpture was constructed by only one or two group members.

Some rubric wording used from Rubistar template: http://rubistar.4teachers.org/

Significant Figures Rules

There are three rules on determining how many significant figures are in a number:

1. Non-zero digits are always significant.
2. Any zeros between two significant digits are significant.
3. A final zero or trailing zeros in the DECIMAL PORTION ONLY are significant.

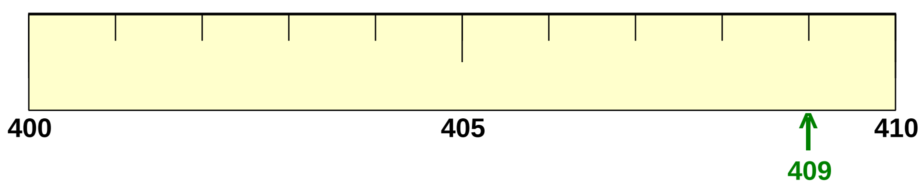
Please remember that, in science, all numbers are based upon measurements (except for a very few that are defined). Since all measurements are uncertain, we must only use those numbers that are meaningful. Not all of the digits have meaning (significance) and, therefore, should not be written down. In science, only the numbers that have significance (derived from measurement) are written.

Rule 1: Non-zero digits are always significant.

If you measure something and the device you use (ruler, thermometer, triple-beam, balance, etc.) returns a number to you, then you have made a measurement decision and that ACT of measuring gives significance to that particular numeral (or digit) in the overall value you obtain. Hence a number like 46.78 would have four significant figures and 3.94 would have three.

Rule 2: Any zeros between two significant digits are significant.

Suppose you had a number like 409. By the first rule, the 4 and the 9 are significant. However, to make a measurement decision on the 4 (in the hundred's place) and the 9 (in the one's place), you HAD to have made a decision on the ten's place. The measurement scale for this number would have hundreds, tens, and ones marked. Like the following example:



These are sometimes called "captured zeros."

Significant Figures Rules

Rule 3: A final zero or trailing zeros in the decimal portion ONLY are significant.

This rule causes the most confusion among students.
In the following example the zeros are significant digits and highlighted in blue.

0.0703**0**
0.008**00**

Here are two more examples where the significant zeros are highlighted in blue.

$4.7\mathbf{0} \times 10^{-3}$
$6.5\mathbf{00} \times 10^{4}$

When Zeros are Not Significant Digits

Zero Type # 1 : Space holding zeros in numbers less than one.
In the following example the zeros are NOT significant digits and highlighted in red.

0.09060
0.00400

These zeros serve only as space holders. They are there to put the decimal point in its correct location. They DO NOT involve measurement decisions.

Zero Type # 2 : Trailing zeros in a whole number.
In the following example the zeros are NOT significant digits and highlighted in red.

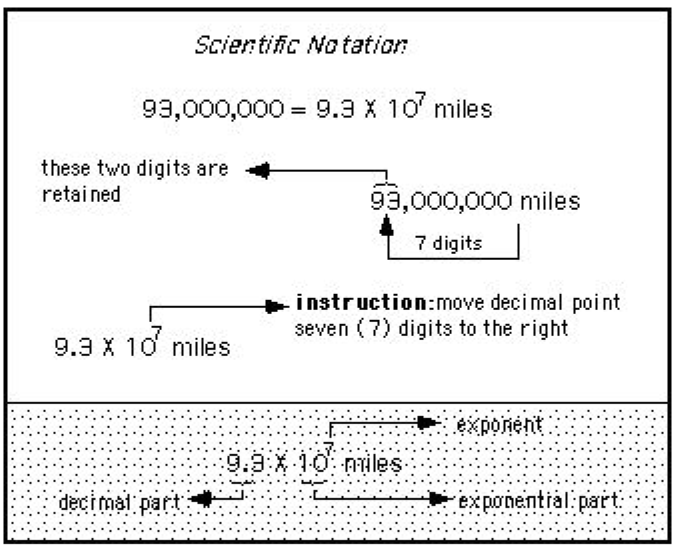
2**00**
25**000**

Scientific Notation

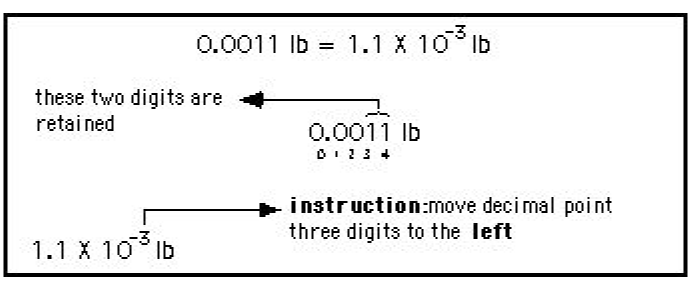
Very large/very small numbers

Very large numbers can be awkward to write. For example, the approximate distance from the earth to the sun is ninety three million miles. This is commonly written as the number "93" followed by six zeros signifying that the "93" is actually 93 million miles and not 93 thousand miles or 93 miles.

Scientific notation (also called *exponential notation*) provides a more compact method for writing very large (or very small) numbers. In scientific notation, the distance from the earth to the sun is **9.3×10^7 miles.**



Very small numbers can be as awkward to write as large numbers. A paper clip weighs a bit more than one thousandth of a pound (0.0011 LB). This would be expressed in scientific notation as 1.1×10^{-3} lb. The negative sign indicates that the decimal point is moved to the left.



Numbers are customarily written with one digit to the left of the decimal point. Numbers may be correctly represented in other ways.

Representing a number using scientific notation

The number 2,398,730,000,000 can be written in scientific notation as (the starred representation is most common):

0.239873×10^{13}

******2.39873×10^{12}**** 23.9873×10^{11}**

239.873×10^{10}

The number 0.003,483 can be written in scientific notation as (the starred representation is most common):

0.3483×10^{-2}

******3.483×10^{-3}**** 34.83×10^{-4}**

348.3×10^{-5}

$3483. \times 10^{-6}$

Scientific notation and multiplication/division

Multiplication and division of large or small numbers is simplified using scientific notation. The decimal parts of the two numbers are multiplied or divided as appropriate to give the decimal part of the answer. The exponents are added together (in the case of multiplication) or subtracted (for division) and provide the exponent for the answer. The answer is adjusted so that only one digit is to the left of the decimal point in the decimal part.

Multiplying numbers written in scientific notation

To multiply 4×10^{4} and 6×10^{5}:

1. Multiply the decimal parts together:

$$4 \times 6 = 24$$

2. Add the two exponents:

$$4 + 5 = 9$$

3. Construct the result:

$$4 \times 10^{9}$$

4. Adjust the result so only one digit is to the left of the decimal point (if necessary):

$$24 \times 10^{9} = 2.4 \times 10^{10}$$

General Rule

$$(a \times 10^{x})(b \times 10^{y}) = ab \times 10^{x+y}$$

Dividing numbers written in scientific notation

To divide 6×10^{5} and 4×10^{4}:

1. Divide the decimal parts:

$$6/4 = 1.5$$

2. Subtract the two exponents:

$$5 - 4 = 1$$

3. Construct the result:

$$1.5 \times 10^{1}$$

4. Adjust the result so only one digit is to the left of the decimal point (if necessary):

$$24 \times 10^{9} = 1.5 \times 10^{1}$$ No adjustment necessary

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General Rule

$$(a \times 10^{x})/(b \times 10^{y}) = a/b \times 10^{x-y}$$

Scientific notation and addition/subtraction

Adding and subtracting numbers written in scientific notation is more complicated than multiplication/division. Consider adding 0.0034 and 0.021:

0.0034			3.4×10^{-3}
+0.021	in scientific notation	--->	$+ 2.1 \times 10^{-2}$
0.0244			2.44×10^{-2}

Now, neither the decimal part or the exponential part combine together in any obvious manner (as they did with multiplication and division). When adding or subtracting numbers written in exponential notation, the numbers must first be rewritten so the exponents are **identical**. Then, the numbers can be added or subtracted normally

Adding/subtracting numbers written in scientific notation

To add 3.4×10^{-3} to 2.1×10^{-2}:

1. Adjust one of the numbers so that its exponent is equivalent to the other number. In this case, change 2.1×10^{-2} into a number which has 10^{-3} as it's exponential part.

$$2.1 \times 10^{-2} = 21 \times 10^{-3}$$

2. Add the decimal parts together:

$$21 + 3.4 = 24.4$$

3. The exponential part of the result is the same as the exponential parts of the two numbers, in this case, 10^{-3}:

$$24.4 \times 10^{-3}$$

4. Adjust the result so only one digit is to the left of the decimal point (if necessary):

$$2.44 \times 10^{-2}$$

Subtraction follows the same procedure except one number is subtracted from the other in (2).

Courtesy of: http://www.brynmawr.edu/nsf/tutorial/ss/ssnot.html

Name ______________________________ Group # __________________

Follow along with the instructional video to complete this graphic organizer.

Write your group's volume of the Quabbin, V_q and the given volume of the wiffle ball structure, V_s in scientific notation, considering significant figures!	
Write your equation using Vq and Vs in the following format (in scientific notation): (*x* is the # of structures) $x = \frac{V_q}{V_s}$	
Using your calculator, divide the significant figures in your equation and subtract the exponents. *(Use the back of this page if you need more room)*	
Write the number of wiffle ball structures that will fill the Quabbin in scientific notation with the correct number of significant figures.	

See document titled *Calculating the Volume of the Quabbin and Wiffle Ball Structure* for a basic format of the pre-work required of the teacher for other Quabbin volumes or numbers of wiffle balls in a structure.