Goals:

- To Answer any lingering questions about why the algorithms work, and gain a deeper understanding
- To show the computational advantages of the Hindu-Arabic number system

Hindu Arabic Number System and its Algorithms

Expanded Form

Expanded form, makes clear how this positional number system is represented. It specifies how the number is valued by explicitly identifying the value of the number.

Express the numbers in expanded form:

3257 1,600,029

How to make use of the Distributive Property

The distributive property says that when multiplying a number by a sum, you must multiply each number in the sum by the number, or in math speak:

$$a(b+c) = ab + ac$$

If you think of numbers in light of their expanded form, you can more easily multiply numbers with a viewpoint that combines expanded form and the distributive property together. This view allows one to more easily multiply numbers in your head.

Examples:
Multiply the following numbers.

$8 * (37)$ $6 * 96$ $7 * 123$ $5 * 1056$ $2 * 1{,}500{,}648$

Addition

What is the one rule with the addition algorithm? Why is it so important?
What is carrying?
How can we add easier in our heads?

Subtraction

Why do we borrow? Can we think of subtraction in other ways?

Counting back money:

Other algorithms based on the idea of adding the missing amount is the same as a difference:

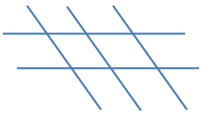
874	793		457	962		874	
- 231	- 457	⇔	+	- 874	⇔	+	
			793			962	

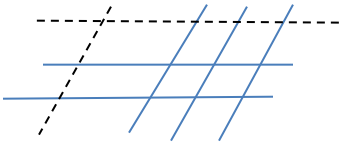
May just be easier to add in your head. Try the examples in your head:

756-234	12,654 – 9,753	36,412 – 500

Multiplication: Japanese Line Method, Napier's Bones, Lattice Method

Japanese Line Method

$3 \cdot 2$ 

$13 \cdot 12$ 

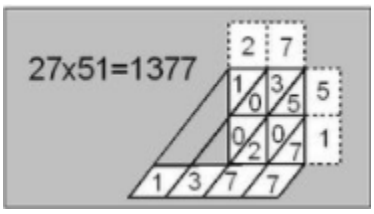
Napier's Bones (see Handout)

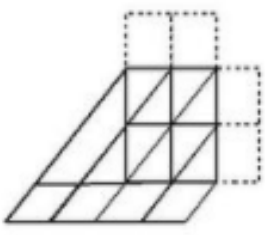
1	9	8	98
2	1 / 8	1 / 6	196
3	2 / 7	2 / 4	294
4	3 / 6	3 / 2	392
5	4 / 5	4 / 0	490
6	5 / 4	4 / 8	588
7	6 / 3	5 / 6	686
8	7 / 2	6 / 4	784
9	8 / 1	7 / 2	882

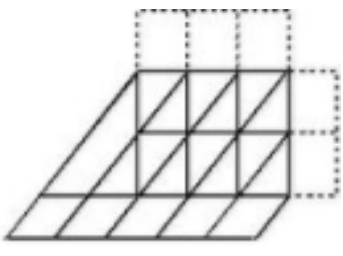
Lattice Method

See handout in note packet

	1	2
1		
3		







Division of Whole numbers

Type equation here.What is division?

$24 \div 6 = 4$ $\frac{24}{6} = 4$ How many 6's are there in 24?

24 is called the **dividend** (the number being divided)
6 is called the **divisor** (the number doing the dividing)
4 is called the **quotient** (the result of the division process)

Repeated Subtraction
Opposite of multiplication
Is it commutative, associative?
How do we check it?

Dividing by 0

The division algorithm and other methods (partial quotients)

How do we do it?

Standard method

$128 \div 8$

Method of partial quotients (works great if you need to essentially guess the correct answer)

$108 \div 12$

Any Other questions for understanding Arithmetic in a deeper way?