

What to bring to class:
Ask students to bring PM
4A and 5A.

1.2 Place Value

last time: * whole #s

* models: set, measurement

* numerals: tally, Egyptian, Roman, Decimal

* place value: value of a digit is specified by its position within number

ex 3437

└─┬─> place value; 10, value 30

└─┬─> place value; 1000, value 3000

1.2 - Place value

Decimal System:
└─> advantages: Place value (simpler notation)
└─> disadvantages: Place value
(tricky concept! Students have difficulty all through elementary school!)

Say: Place value is so ingrained in adult minds. Difficult to appreciate importance & how hard it is to learn.

Decimal numbers formed by:

Place Value Process {
Step ① Form bundles of 1, 10, 100...
Step ② If necessary rebundle to ensure at most 9 bundles of each denomination
think of : 10 pennies = 1 dime
Step ③ Record number of each type of bundle in the appropriate position.

Say: Given a pile of pennies, dimes and dollars,
how do you represent a 3-digit number?
The act of creating a 3-digit numeral is a process!
This process underlies nearly everything in elem. math.

Step ① Put pennies in piles of ten

Step ② Exchange each pile of 10 pennies for a dime.

Step ③ Exchange groups of 10 dimes for a dollar.

Example: K-3 problems which teach place value

* Counting by tens (step ①)

* Switching decades (what comes after 39? 59? 99? (step ②))

* Thinking of 1482 as 14 hundreds + 82 ones
or 1 thousand + 48 tens + 2 ones (step ②)

→ * What is 20 more than 247? (step ③)

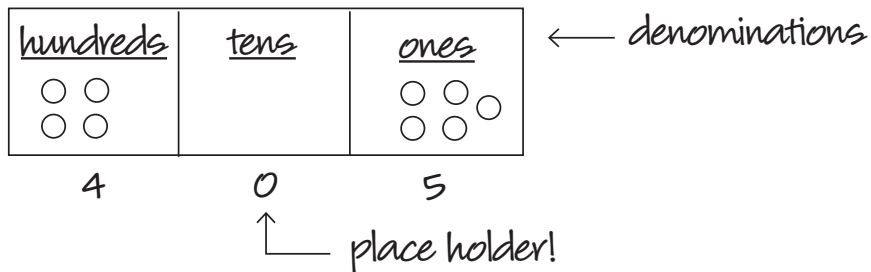
Say: easier than "is more." It is place value not addition.

Models/Teaching Sequence:

① Base 10 blocks

SHOW CLASS - convey the idea of bundles of 10, but not the main idea of Place Value (position determines value.)

② Chip Model



③ Expanded form:

3874 means 3 thousands + 8 hundreds + 7 tens + 4 ones
3000 + 800 + 70 + 4

Note: Egyptian numerals already in expanded form:

$$\underbrace{ee}_{200} \underbrace{111}_{30} \downarrow = 231$$

200 30 1

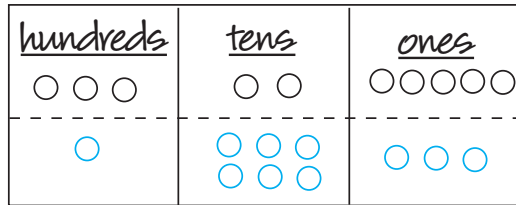
④ Decimal numerals: instead of $200 + 30 + 1$ we write 231.

Place value in:

Adding - simple principle : separately add ones, tens, hundreds.

Example: (easier) $325 + 163$

① Chip Model



② Expanded form:

$$\begin{array}{r} 300 + 20 + 5 \\ 100 + 60 + 3 \\ \hline 400 + 80 + 8 \end{array}$$

③ Decimals:

$$\begin{array}{r} 325 \\ + 163 \\ \hline 488 \end{array}$$

(note - each step further from actual counting)

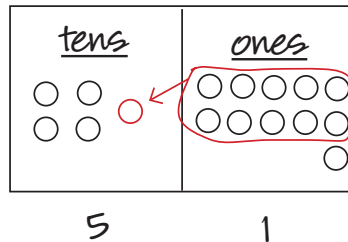
* avoiding hard step ② - regrouping.

* can add columns in any order! Why?

Harder examples involve step ② - regrouping

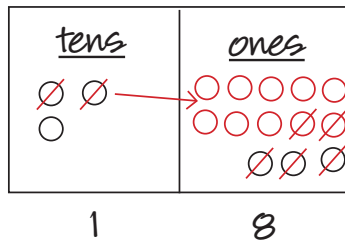
composing: ("carrying" may be misleading, really exchanging)

$$\begin{array}{r} 38 \\ + 13 \\ \hline \end{array}$$



decompose: ("borrowing" misleading, exchanging)

$$\begin{array}{r} 33 \\ - 15 \\ \hline \end{array}$$



(these problems are harder (with step ②) should be done later)

Note: "tens combinations" (1 + 9, 2 + 8, 3 + 7, 4 + 6, 5 + 5)
helps with regrouping

Ex: * $60 - 8 = 50 + (10 - 8) = 52$

* $75 + 7 = 75 + 5 + 2 = 82$

Place Value in multiplication:

* "Multiply by 10" is done by "appending a zero"

Replace each penny w/ dime
dime w/ dollar } \Rightarrow shift digits

* Special feature of place value. Wouldn't work for 9!

① Recall HW set 1 #7

$$e11111 \times 10 = 2ee1111$$

② pennies \longrightarrow dimes

dimes \longrightarrow dollars

Classroom Exercises: Show how Place Value is used to get answer

* $13 \times 10 = 13 \text{ tens} = 130$

* $321 \times 10 = (3 \text{ hundreds} + 2 \text{ tens} + 1) \times 10$
 $= (3 \text{ thousands} + 2 \text{ hundreds} + 1 \text{ ten}) = 3210$

* $5 \times 50 = (5 \times 5) \times 10 = 25 \text{ tens} = 250$

* $24 \times 100 = 2400$

Ordering: (provides exercises which test & challenge place value understanding)

Fill in < or >

* $57 > 39$ good

* $64 > 46$ good

* $57 < 89$ not good! could get right answer for the wrong reason

Summary:

Easier problems - steps ① & ③ only (teach 1st)

Harder - all 3 steps

HW - Read 1.2 & do HW set 2.