

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

3.3-Multiplication Algorithm

Mental math:

(in-class ex
 1-min each
 step)

Step 1: $11^2=121$

$$12^2=144$$

$$13^2=169$$

$$14^2=196$$

$$15^2=225$$

$$16^2=256$$

Step 2: Use facts to calc

a) 11×12

b) 14×15

c) 16×18

d) 22×12

Teacher knowledge: Using Place Value (PV) & Distributive Property (DP) every "x" can be reduced to a series of 1-digit "x".

Stage 1: 1-digit x (2 or 3 digit)

Ex: $3 \times 145 = 3 \times (100+40+5)$	PV (Expanded Form)
$= 300+120+15$	DP
$= 435$	PV

Stage 2: 2-digit x (2 or 3 digit)

Ex: $23 \times 145 = (20+3) \times 145$	PV (Expanded Form)
$= (20 \times 145) + (3 \times 145)$	DP
$= 10 (2 \times 145) + (3 \times 145)$	Any-Order



*Stage 2 problems reduce to stage 1 which reduce to 1-digit "x".

Teaching Remarks: PV & DP should be repeatedly covered before & during the teaching of the algorithm.

Models: Distributive Property: rect. array
 Place Value: chip model

Teaching Stages:

1) (Grade 3 & 4)

a) 1-digit mult. in different P.V.

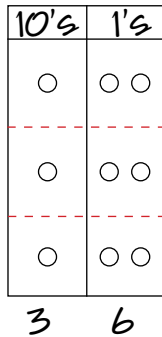
6	60 ← 6 tens	600	(PM 3A p49)
<u> </u> x 4	<u> </u> x 4	<u> </u> x 4	
24	240 ← 24 tens	2400	

b) Multiplication without regrouping.

(PM 3A p50 pr 2)

Ex: 3x12

1) chip diagram



2) Algorithm Format

$$\begin{array}{r} 12 \\ \times 3 \\ \hline 36 \end{array}$$

3) step-by-step

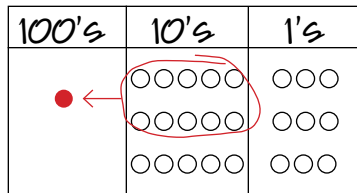
$$\begin{array}{r} 12 \\ \times 3 \\ \hline 6 \\ + 30 \\ \hline 36 \end{array}$$

4) Distributive Property highlighted

$$\begin{array}{r} (10+2) \\ \times 3 \\ \hline 30+6 \end{array}$$

c) Mult w/ regrouping in top denomination

$$\begin{array}{r} 53 \\ \times 3 \\ \hline 159 \end{array}$$



* do model & abstract at the same time

*why easier in top den?

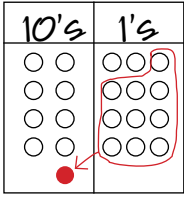
*mult ones: 3x3=9

*then (5x3) tens = 15 tens

*then regroup

d) Mult with regrouping in lower denominations

Ex:
$$\begin{array}{r} 23 \\ \times 4 \\ \hline 92 \end{array}$$



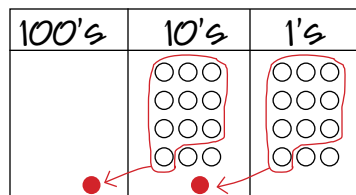
$*3 \times 4 = 12 \text{ ones}$
 $= 1 \text{ ten} \ \& \ 2 \text{ ones}$

$*(2 \times 4) \text{ tens} = 8 \text{ tens}$
 $+ 1 \text{ more}$
 9 tens

e) Double regrouping

Ex:
$$\begin{array}{r} 33 \\ \times 4 \\ \hline 132 \end{array}$$

have students try
in gps of 2
(use chip model)



$*4 \times 3 = 12 \text{ ones}$
 $= 1 \text{ ten} + 2 \text{ ones}$

$*4 \times 3 \text{ tens} + 1 \text{ ten} = 12 \text{ tens} + 1 \text{ ten}$
 $= 1 \text{ hun} + 3 \text{ tens}$

Stage 2: (Grades 4 & 5)

a) Review stage 1

b) Mult by 10, 20, ..., 90

Ex: $12 \times 40 = 12 \times 4 \text{ tens} = 48 \text{ tens} = 480$

or
$$\begin{array}{r} 12 \\ \times 40 \\ \hline 480 \end{array}$$

stage 1
& shift Place Value

c) Together

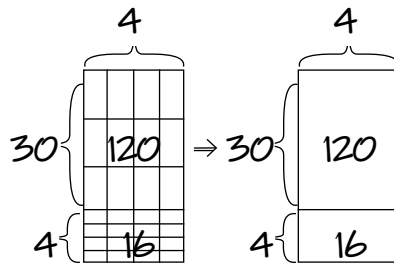
$$\begin{array}{r}
 24 \\
 \times 13 \\
 \hline
 72 \quad \leftarrow 24 \times 3 \\
 \underline{240} \quad \leftarrow 24 \times 10 \\
 312 \quad \leftarrow \text{total}
 \end{array}$$

* Then practice in Word Problems

Alternate Algorithm: (say: still uses place value & distributive property)

Ex 1:

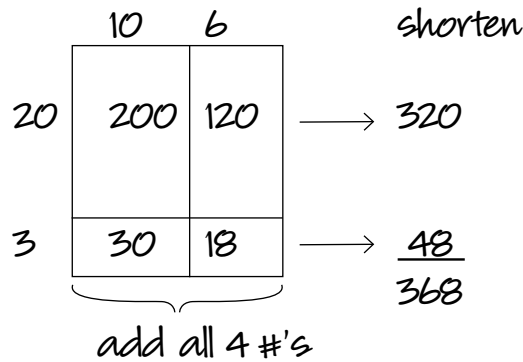
34×4



$$\begin{array}{r}
 34 \\
 \times 4 \\
 \hline
 \del{132} 16 \\
 + \del{36} 120 \\
 \hline
 136
 \end{array}$$

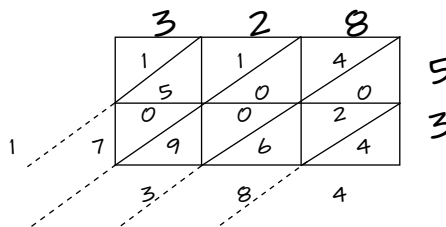
Ex 2:

$$\begin{array}{r}
 23 \\
 \times 16 \\
 \hline
 18 \\
 120 \\
 30 \\
 \underline{200} \\
 368
 \end{array}$$



Lattice Method: *Be very careful of arrangement.

$$\begin{array}{r}
 328 \\
 \times 53 \\
 \hline
 17,384
 \end{array}$$



Uses:

- *1-dig mul
- *Place Value
- *lattice=array

Try: 2874×19