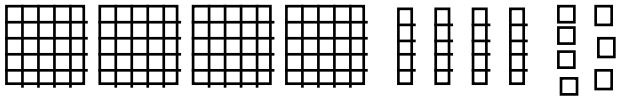
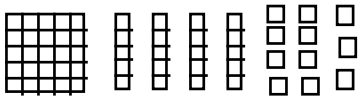
A PLACE VALUE SYSTEM

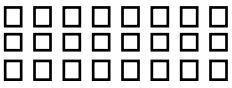
You have pieces of paper in four sizes: unit, long (5 units), flat (5 longs) and long-flat (5 flats), or if not, you can find them in appendix D. You can use these ``manipulatives'', as we say in the education business to see how to represent numbers in the base five system.

Example: Make a collection of 8 units, 6 longs and 5 flats. Then in all cases where you can possibly do so, trade in 5 pieces of one size for one of the next size larger. The resulting collection should contain 1 long-flat, 1 flat, 2 longs and 3 units. The two collections are called *equivalent* because they contain the same number of unit squares, but the second has the minimum number of pieces, and that is the collection you would use for an official representation of the number in question.

1) Make each of the collections below, then do exchanges until you have the minimum possible number of pieces. Record the result in the table below.

a) 

b) 

c) 

	long-flats	flats	longs	units
a				
b				
c				

2) Explain why you never had to write a numeral larger than 4 in the table.

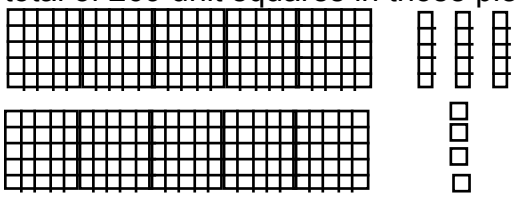
3) Using base 5 pieces, you can represent a collection of 28 units by a minimal collection of 1 flat, 0 longs, and 3 units. This is recorded on the table below.

Using base-five pieces to aid visualization, supply the missing entries in the following table:

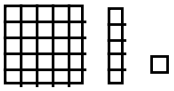
number of unit squares	long-flats	flats	longs	units	
28	0	1	0	3	
31					
126					
200					
	0	1	2	3	
	3	3	0	3	
	4	4	4	4	

4) Minimal collections of base-five pieces can be recorded without using a table. For instance, the first entry in the table can be written as $103_{five.}$ Written that way, it is called a *base five numeral*. Write the base five numerals for all of the collections described in 3 in the empty column at the right hand side of the table.

5) The base five pieces that represent $2034_{five.}$ are shown below. There are a total of 269 unit squares in those pieces.



Represent the following numbers with your base five pieces and figure out the total number of unit squares in each one: $1032_{five.}$, $2004_{five.}$, $1203_{five.}$,

6) Here are the first 3 number pieces for a base five collection: 

Now you draw the first three pieces for a base three collection, and then for a base ten collection.

7) Draw a diagram of the collection of base pieces representing each of the following numbers. Then determine the total number of unit squares in each collection.

a) 122_{three} b) 425_{seven} c) 157_{ten}