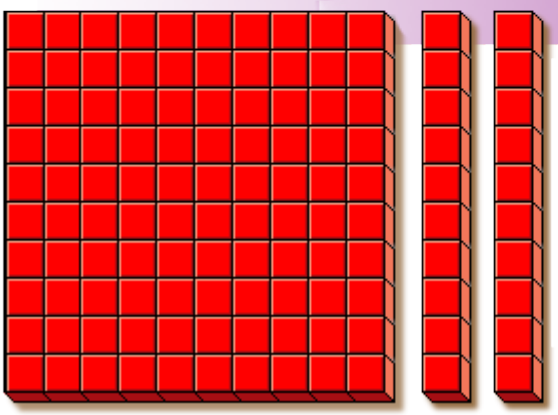
Ventura®
Educational Systems

Tools for Active Teaching and Active Learning

Hands-On Math

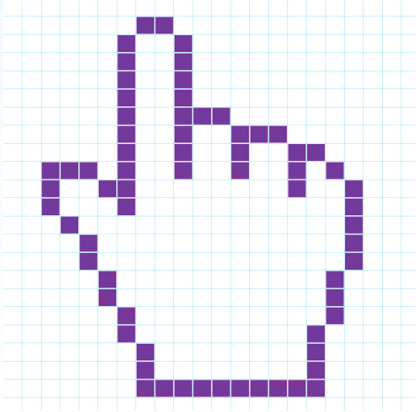
Base Ten Blocks



Explore and Discover:

- ✔ Place Value
- ✔ Addition and Subtraction
- ✔ Whole Numbers & Decimals
- ✔ Number Theory

Instructor's Guide



Ventura Educational Systems

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Credits

App Design Ventura Educational Systems

Instructional Technology and Programming Fred Ventura, Ph.D.
Ben Ventura
Jon Ventura

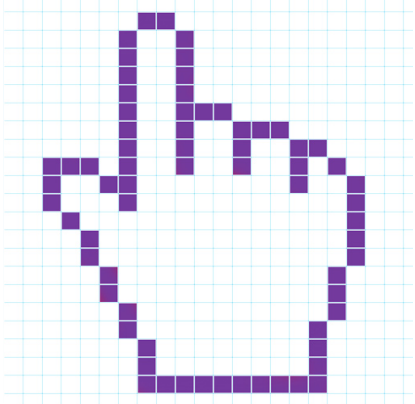
Project Manager Marne Ventura

Dr. Fred Ventura is an experienced classroom teacher and has taught elementary, secondary and college levels. He holds a doctorate in education from the University of California and presents workshops for educators on the instructional uses of technology.

Marne Ventura is an experienced classroom teacher and holds a masters degree in reading and language development of the University of California.

Ben Ventura is a systems administrator and programming expert. He attended Sonoma State University and works as a consultant to public agencies and private companies.

Jon Ventura is a Ph.D. candidate in the Department of Computer Science at the University of California, Santa Barbara.



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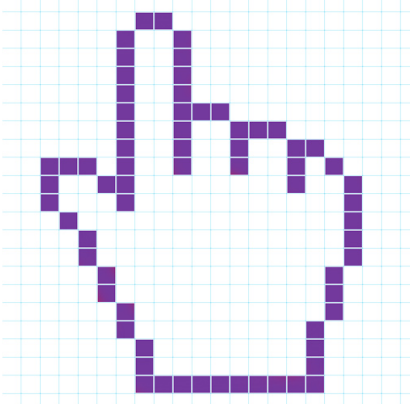


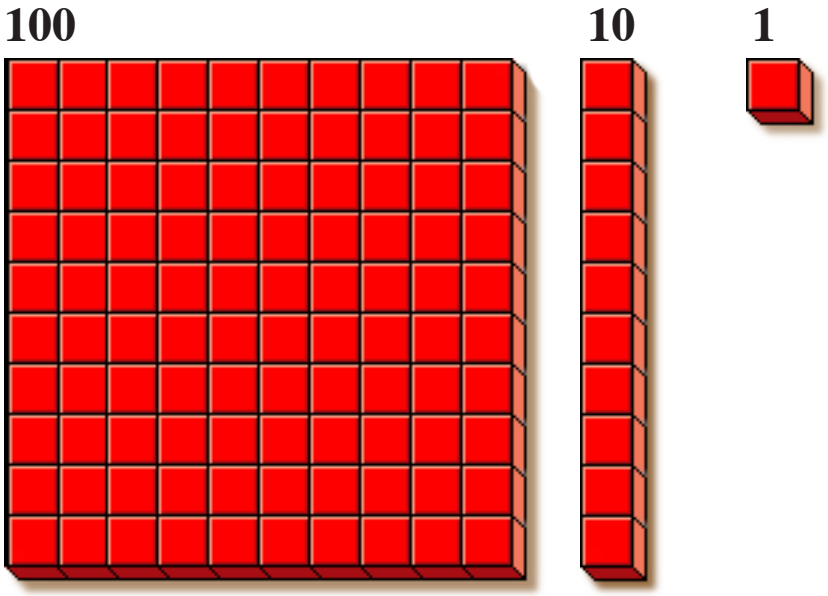
Overview

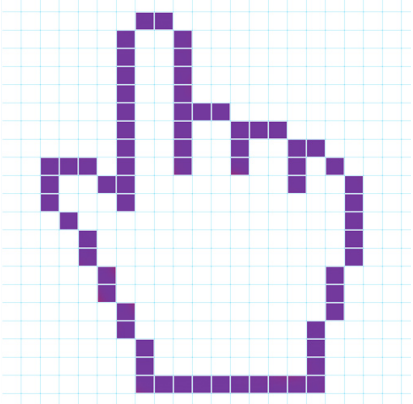
The use of a Base Ten Blocks is one of the best ways to give students an insight into the base 10 numbering system commonly used in mathematics. Mathematics took a giant step forward when people learned to use a positional numbering system to represent numbers. Roman numerals and other early ways that were used to represent number were severely limited in their ability to represent large numbers and operations such as addition and subtraction were not easily performed. Base Ten Blocks is designed to help children develop an understanding of place value. In order for a child to develop a meaningful understanding of mathematics it is essential that the child know the underlying concepts that are the cornerstone of the representational place value system. After a student has developed clear understanding of addition and subtraction as operations involving the joining and separating of sets, he or she is ready to begin the systematic study of numbers greater than 9.

The decimal system employs only ten digits: 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9. Children must learn that the position of a given digit in a number determines its value. For example, in the number 387 the 3 represents 3 sets of one hundred, the 8 represents 8 tens and the 7 represents 7 ones.

The Base Ten Blocks app turns your iPad into a interactive tabletop surface that we call a Playground. The Playground provides the child with an opportunity to freely explore place value concepts. The Playground provides three types of blocks for each decimal place setting.

Visualizing mathematical concepts is the key to understanding. Models help significantly in cognitive development.





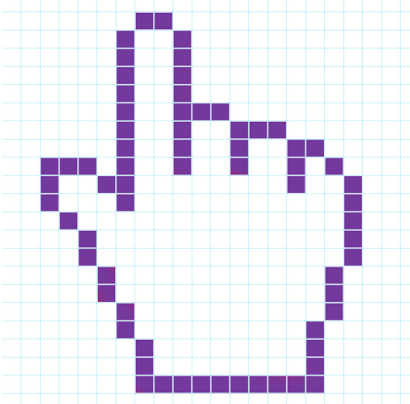
Research has shown that children learn best through active involvement in the learning process. Hands-On Math: Base Ten Blocks is designed to be a tool that teachers can use for active teaching and active learning. Math manipulative devices can be a rich source of teaching strategies for problem solving and can be very helpful in developing an intuitive understanding of mathematical concepts. The Hands-On Math series

suggests ways in which concrete learning experiences can be extended to a representational level and still remain manipulative and interactive.

This guide consists of two sections. The first part is written for the teacher and explains the functions of the app and options available. It presents ideas for instructional strategies that can be implemented with each simulated manipulative device. The second section of the manual is a set of curriculum-based activities that are designed to help the teacher in using the Hands-On Math app. These activities have been developed for elementary and middle school age children and are arranged by order of grade level where the concepts are typically introduced. Teachers will want to decide what is the best sequence for using the materials with their particular group of students. Each lesson is aimed at specific mathematical objectives including counting, representing numbers using the place value system, addition and subtraction with regrouping. Each activity is meant to be a beginning. Teachers will want to encourage the children to explore extensions of each activity with different examples. Orally discussing each activity will help to foster higher level thinking.

Hands-On Math: Base Ten Blocks is a starting point. Learning should be fun and as students work with the app, it is my intention that they will begin discussing, sharing and creatively exploring mathematics.

-- Fred Ventura, Ph.D.



Introduction to Hands-On Math: Base Ten Blocks

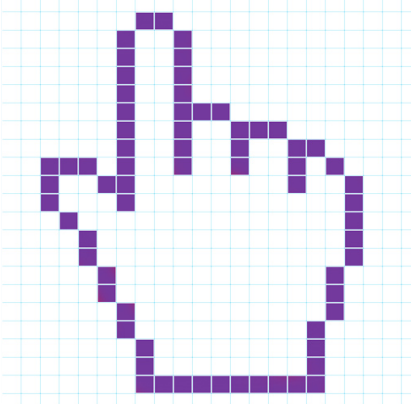
Approaches to the teaching of mathematics that rely heavily on one methodology are inherently weak and unlikely to produce optimal results. Educators have found that teaching strategies must adapt to accomodate new discoveries which expand our understanding of the learning process and new technologies which expand our delivery systems.

According to learning theory, children learn best when they are actively involved in the learning process. There are many ways to do this but one example is having children work in small groups in a laboratory/discovery situation. Small group instruction encourages variation in teaching methodology. Variation in the way in which material is presented serves the instructional process since one particular methodology may not be best for all children. Different children respond differently to a particular educational approach. The same methodology that is appropriate for one content area or developmental stage may not be appropriate in a different content area or with children who are at a different developmental stage.

For learning mathematics an active teaching and active learning situation is a very desirable educational environment. To create it the teacher must be aware of the behavioral characteristics of the students with regard to mathematics, must be knowledgeable in the particular skills which are being taught and must be able to draw upon diverse strategies in order to decide which is the most appropriate for fostering the development of the targeted mathematical concepts.

Piaget's theory of cognitive development is a comprehensive theory about the nature and development of human intelligence.

In general, educational psychologists believe that the ability of children to learn passes through developmental stages. Each stage is characterized by particular behaviors. In the early stages learning is tied to perceptual responses. As the child matures, abstract reasoning becomes possible and concrete models are useful for laying the conceptual groundwork for new ideas, but once a concept has been internalized the concrete models are no longer necessary. The work of Swiss psychologist, Jean Piaget, has contributed a great deal to support this theory, and to foster the development of educational strategies which are consistent with the theory.



Using an iPad in a Manipulative Approach to Math

Hands-On Math: Base Ten Blocks combines and extends the use of concrete materials for teaching mathematics to the touch-based interactive enviroment of the Apple® iPad™. When used in conjunction with actual manipulative devices the app offers a unique set of strategies for active learning. While using the app students can draw upon concepts developed from concrete experiences that were gained using manipulative devices and will work with the same concepts in a more representational manner using the app. In this way the child's concrete mathematical knowledge is used to help transition to a representational stage and serves as a foundation for the development of abstract mathematical thinking skills.

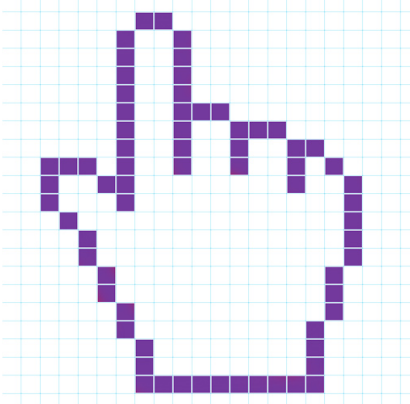
Once mathematical concepts have been internalized by the child in a concrete way, the stage is set for a deeper understanding of the more formal, abstract axioms of higher mathematics.

Hands-On Math: Base Ten Blocks simulates the use of a unit block (1×1), a ten block (10×1) and a one hundred block (10×10). Using the blocks numbers from 0 to 999 can be represented. Traditionally students would use physical blocks made of wood or plastic. The app simulates these instructional approaches by creating an open-ended area called the Base Ten Blocks Playground. On the Base Ten Blocks Playground students manipulate a supply of blocks to represent numbers and to perform additions and subtractions.

We use the term "playground" to convey the open-ended, discovery approach to learning that this tool was designed to support.

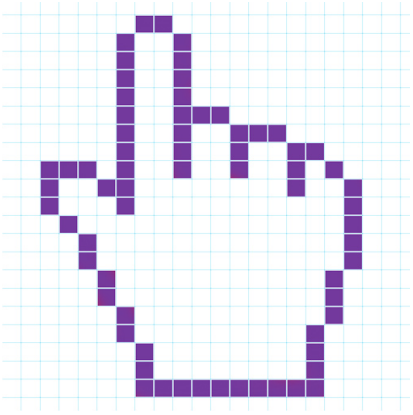
Using the Base Ten Blocks Playground students can exchange a hundred block for 10 tens, or a ten block for 10 ones. The author and designer coined the term, "artificially intelligent math manipulative" to describe how using the Base Ten Blocks differs from concrete manipulative devices traditionally used in classrooms. The Base Ten Blocks on the Playground provide intelligent feedback as the student manipulates the blocks.

The Base Ten Blocks Playground can also be used with lessons that present mathematical concepts in a structured way. Initially teachers may want to provide ample free exploration time and then after the students have become familiar with the product, direct students into more structured investigations. Students will make discoveries and when they do teachers should encourage them to share their discoveries with others in their group.

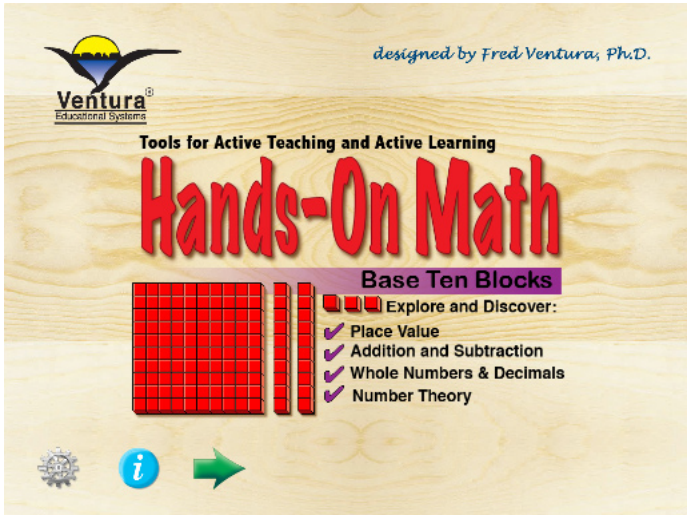


Getting Started

Hands-On Math: Base Ten Blocks helps develop an understanding of place value. The program is designed in such a way that the physical operation of the app does not interfere with the learning activity. Icons are used to provide the user with complete control over the interaction with the software features.



Tap the Base Ten Blocks icon to launch the app.

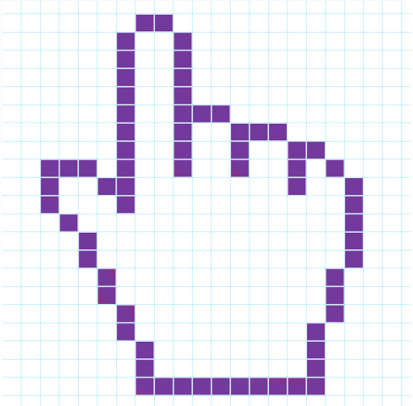


The opening view presents the title page with three options:

Settings - Tap this icon to control the sound, speech and view options of the app.

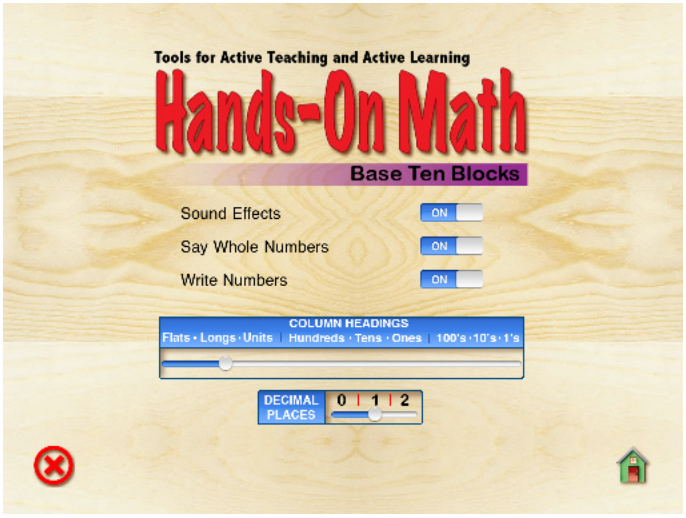
Info - Tap this icon to access the User's Guide where an overview of the app is presented.

Begin - Tap the green arrow to start using the Hands-On Math: Base Ten Blocks Playground.



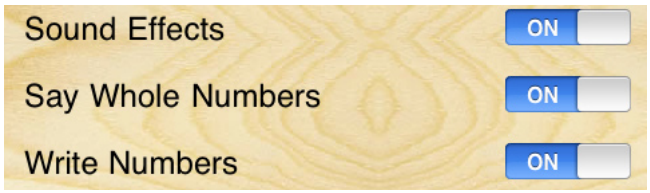
Settings

The Settings option provides control of some of the basic features of the app. Options include control for sound effects and speech.

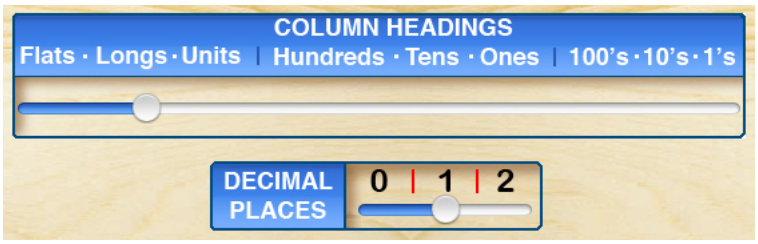


Mild sound effects are used through out the app and add a level of interest for students. When using the app with very young students teachers may wish to have the Speech option on. When Speech is on the name of each number is pronounced when a block is placed on the Base Ten Blocks Playground.

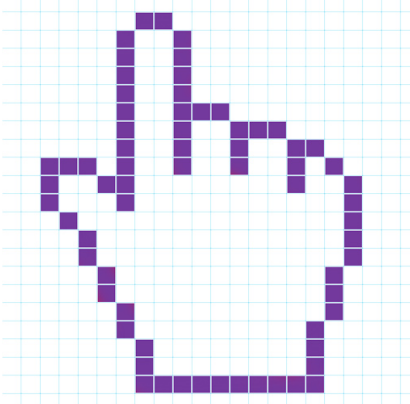
Use Speech effects with very young children to help them learn to read and write numbers.



Use the on/off switch to activate or deactivate the sound effects, and the speech or the writing of numbers. The default option for writing numbers is to use words, but tapping the words toggles the display to expanded notation. Note: 'Say Whole Numbers' only applies to the zero decimal places setting.



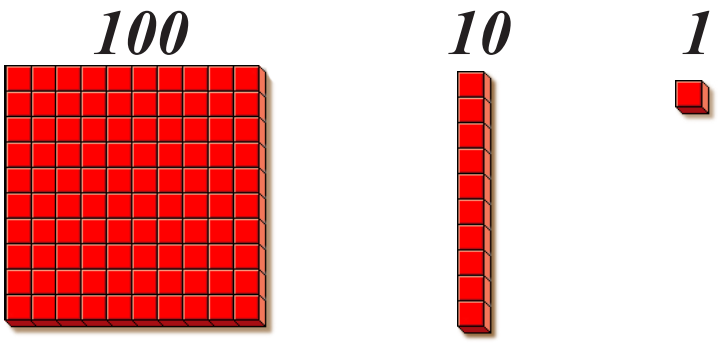
Use the slide control to slect the appropriate headings to be used for the place value column shown on the Playground. Set the number of decimal places. Note: Flats, Longs, and Units only applies to the zero decimal places setting.



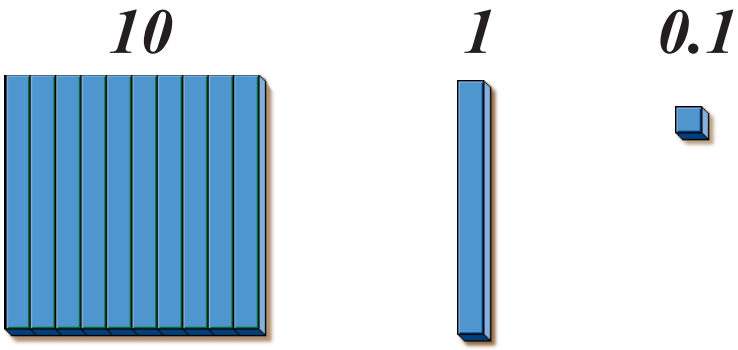
Decimal Places Setting

The Decimal Places Setting determines which set of blocks is used on the Base Ten Blocks Playground.

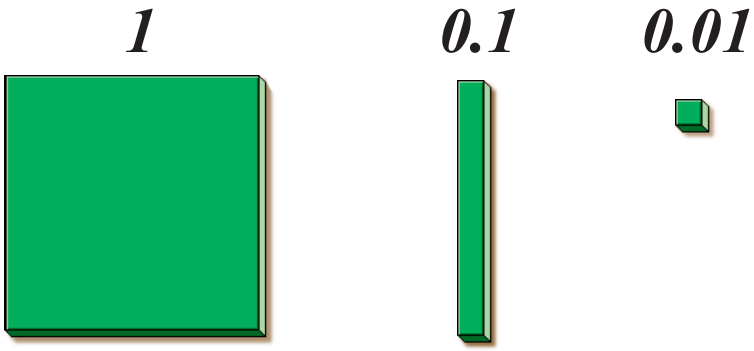
These blocks are used for the zero decimal places setting:

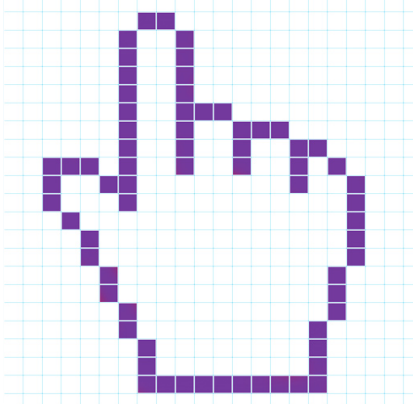


These blocks are used for the one decimal place setting:



These blocks are used for the two decimal places setting:





In App User's Guide

Tapping the Info icon brings up the Hands-On Math User's Guide. The guide provides a quick overview to the features of the app. It serves as a quick reference to the use of the product.

Users can navigate by tapping either the right or left arrows. Swiping right or left can also be used to move to the next page or previous page.

Exit the user's guide by tapping the home icon.

Next Page - Tap this icon to move to the next page.

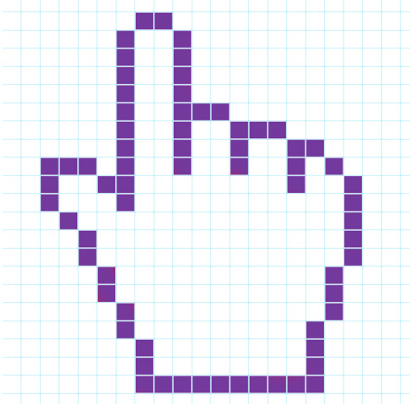
Previous Page - Tap this icon to move to the next page.

Instructor's Guide - Tap to automatically begin downloading the PDF of the Instructor's Guide from www.venturaes.com. We recommend you install the Instructor's Guide in iBooks for convenient reference.

Tap the World Wide Web icon to launch your iPad browser and view the Ventura Educational Systems Website.

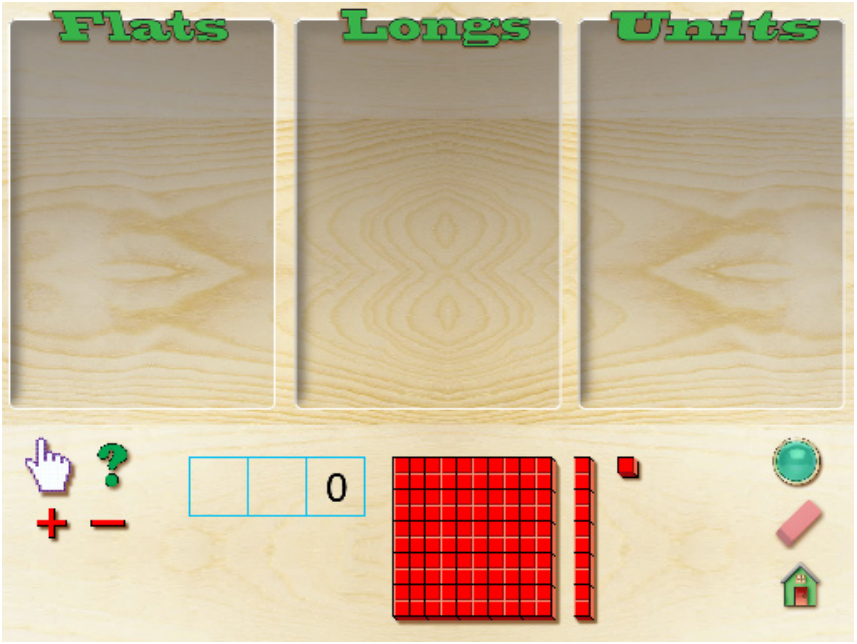
Home - Tap this icon to exit from the User's Guide.

Swipe right or left to change pages or use the buttons.

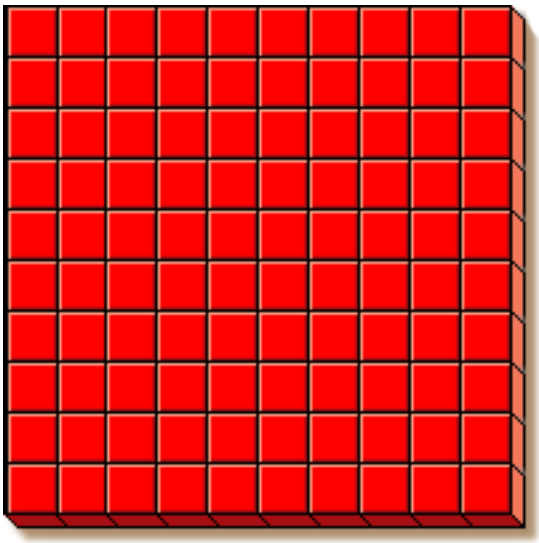


Base Ten Blocks Playground

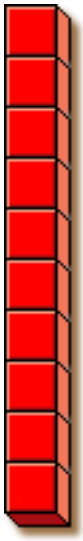
The Base Ten Blocks Playground is where the fun begins. Tap the green arrow to get started. You will notice that at the top of the screen there are three trays designating the place value columns.



At the bottom of the screen there are several icons and three stacks of Base Ten Blocks. The Base Ten Blocks are designated as follows depending on the setting:

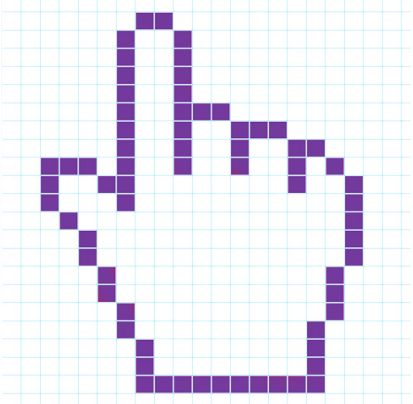


Flat
Hundreds
or 100's



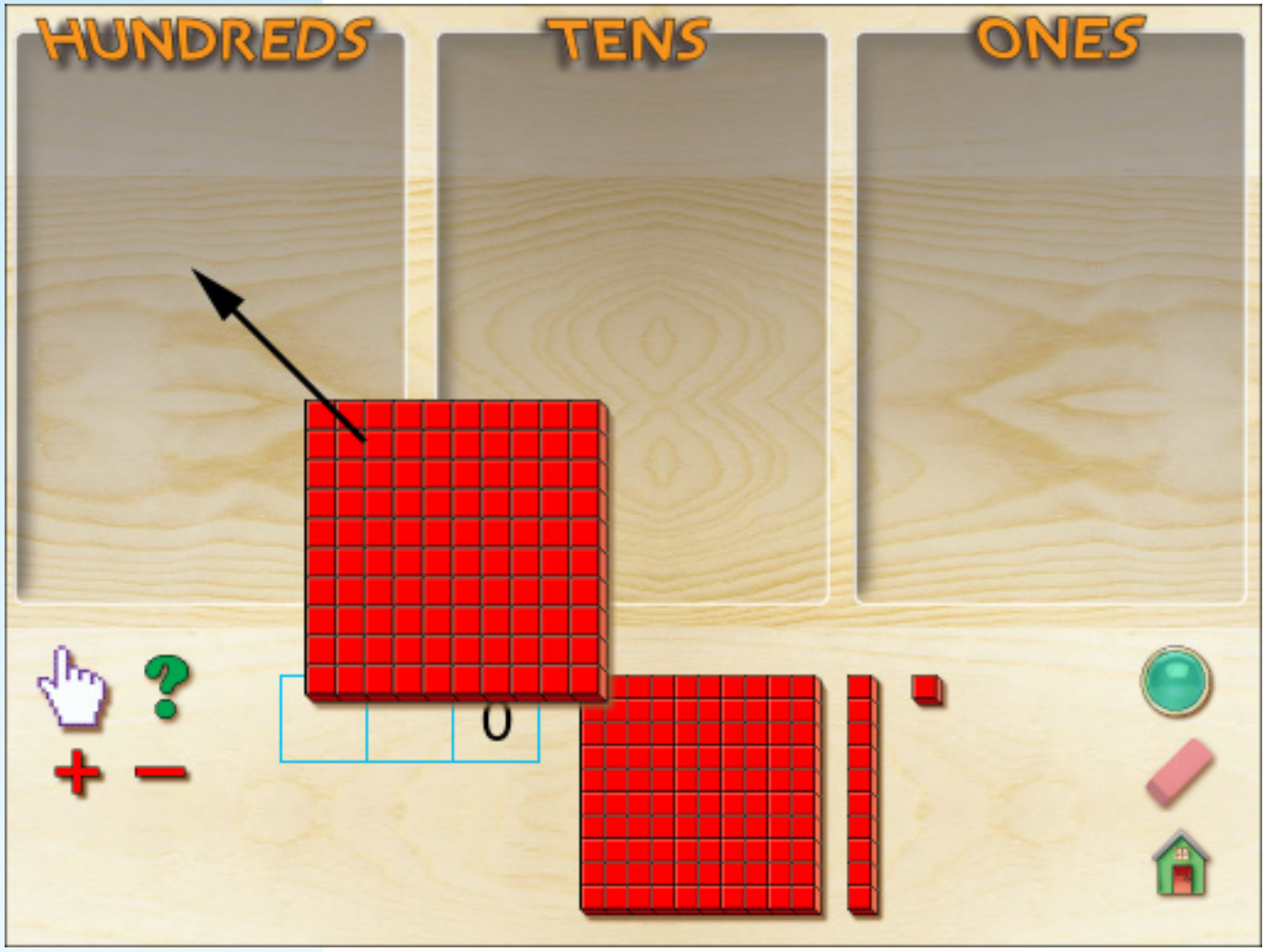
Longs
Tens
10's

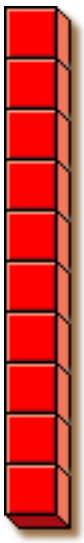
Units
Ones
1's



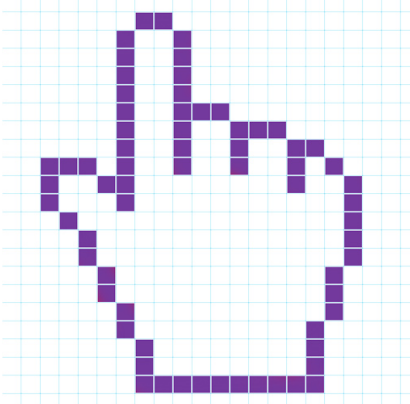
Placing Base Ten Blocks on the Playground

To move a Base Ten Block on the Playground drag it to the appropriate tray. Nine Hundreds Blocks can be placed in first tray or hundreds column. Eighteen Tens Blocks can be placed in the second tray or tens column and eighteen Ones Blocks can be placed in the third column or ones (units) column.





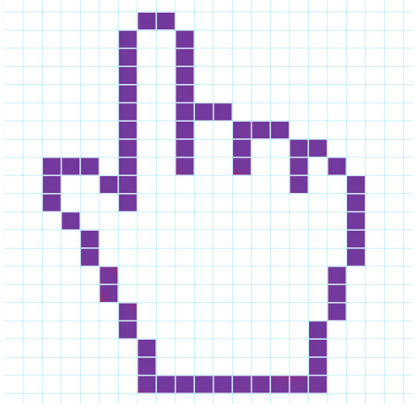
Tap the eraser icon to remove all the blocks from the Playground. Tens and Ones (Units) Blocks can also be placed in the trays. Blocks will only go into the appropriate column. Auditory and visual feedback is given when a block is placed in an inappropriate column.



Tens

Ones (Units)

Activities



Place Value

Settings

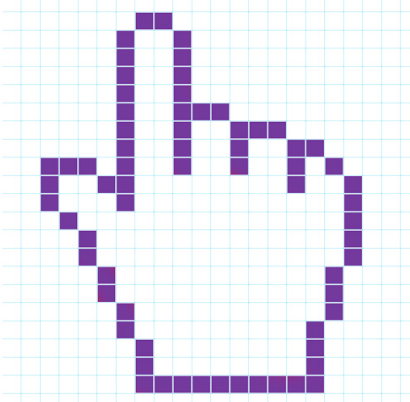
Sound Effects

Say Whole Numbers

Write Numbers

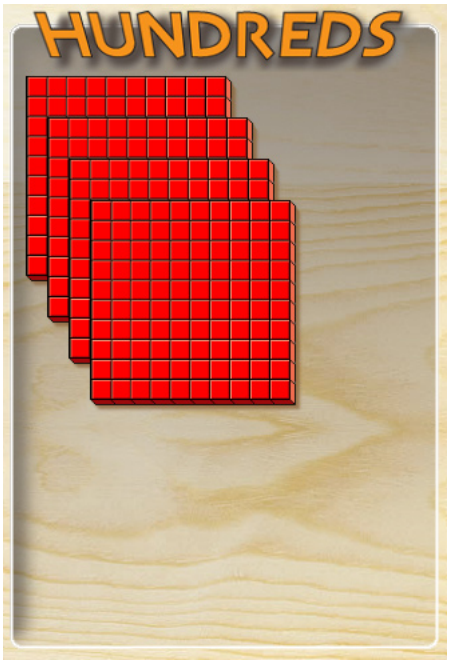
Hundreds | Tens | Ones

Eraser



Let's begin exploring the Hands-On Math: Base Ten Blocks Playground by representing a number using the Base Ten Blocks. From the Home screen tap the Settings icon. Let's represent 413. Tap the Erase to clear the Playground. Begin by dragging a Hundreds Block to the first column on the left. To represent 400, drag a total of four Hundreds Blocks to this tray.

413



Steps:

1. Drag 4 Hundreds Blocks to the Hundreds tray (column).
2. Drag 1 Tens Block to the Tens tray (column).
3. Drag 3 Ones blocks to the Ones tray (column).

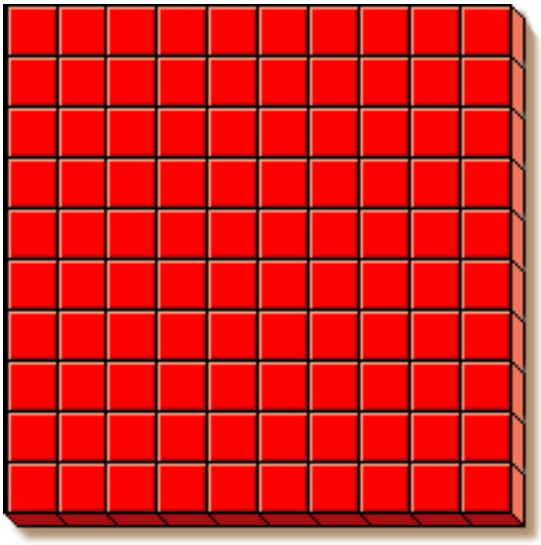
Place Value: Naming Numbers

The place value system is based on the concept of groups. Using Base Ten Blocks, children will develop an understanding of grouping in powers of ten. Activities that involve representing numbers using Base Ten Blocks or telling which number is represented by a set of blocks reinforce a childes comprehension of the decimal system.

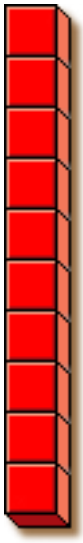
Because the computer graphic representations used in this app allow blocks to be separated and joined to show regrouping children can easily discover fundamental concepts such as the idea that a Ten block can be exchanged for 10 ones. By manipulating the physical materials, and then by simulating the manipulation of physical materials using the computer, children are given the opportunity to internalize the basic ideas of the decimal place value system.

Some suggestions of worthwhile activities are the following:

1. Tell the name and give the dimensions of each block.

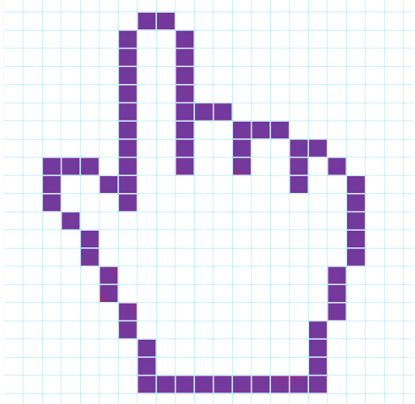


Hundreds Block
10 × 10



Tens Block
10 × 1

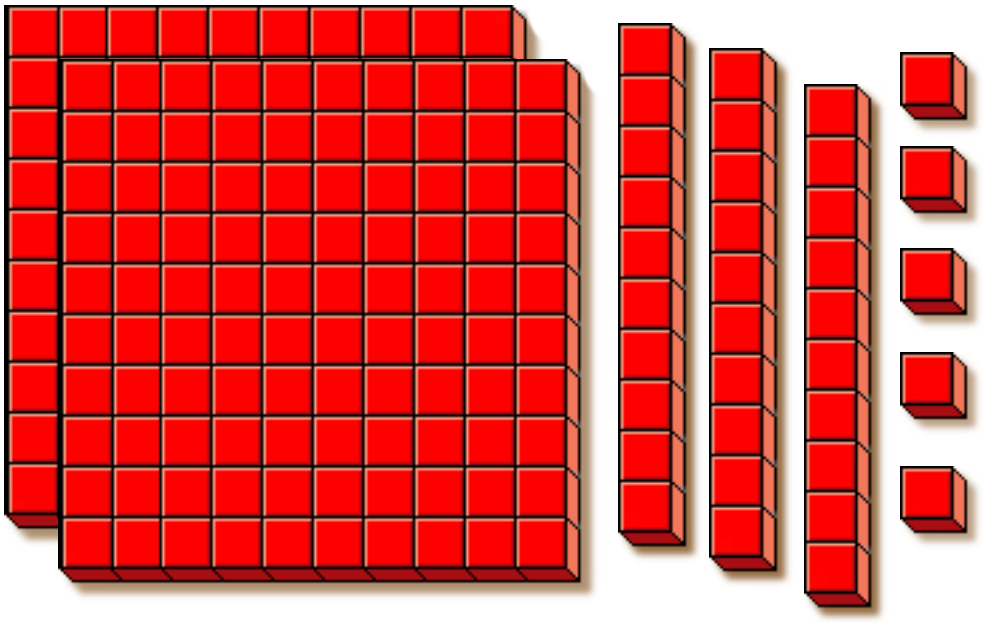
Ones Block
1 × 1



Place Value: Naming Numbers

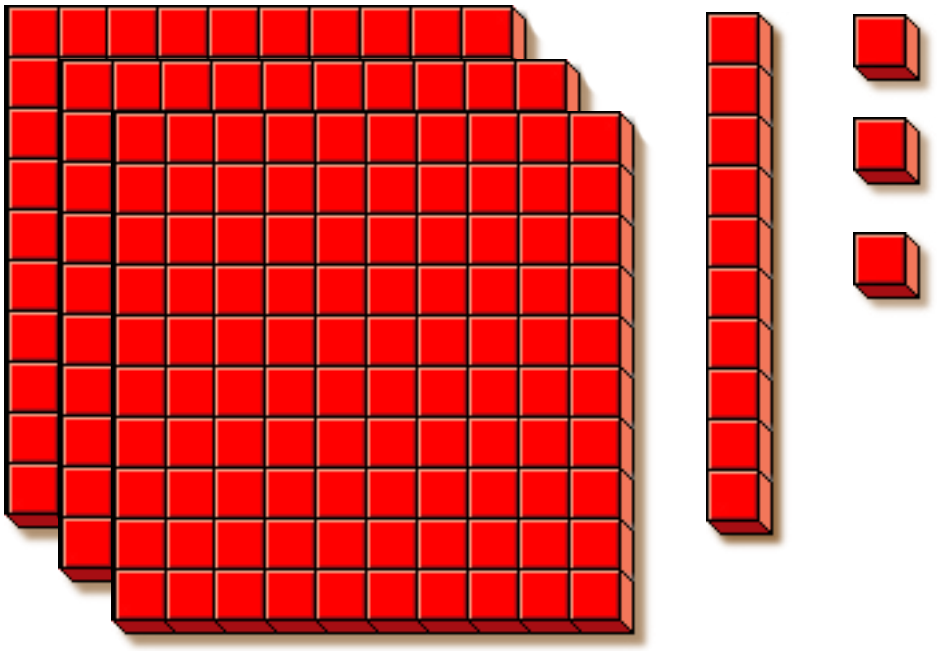
2. Give the value of the number represented by a set of blocks.

A.



235

B.



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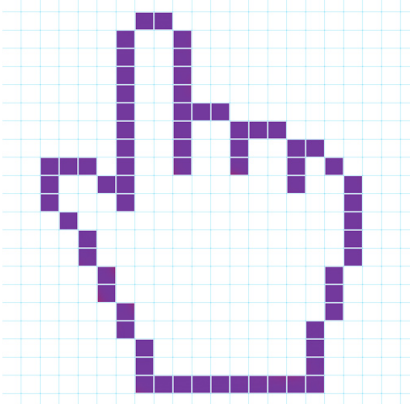
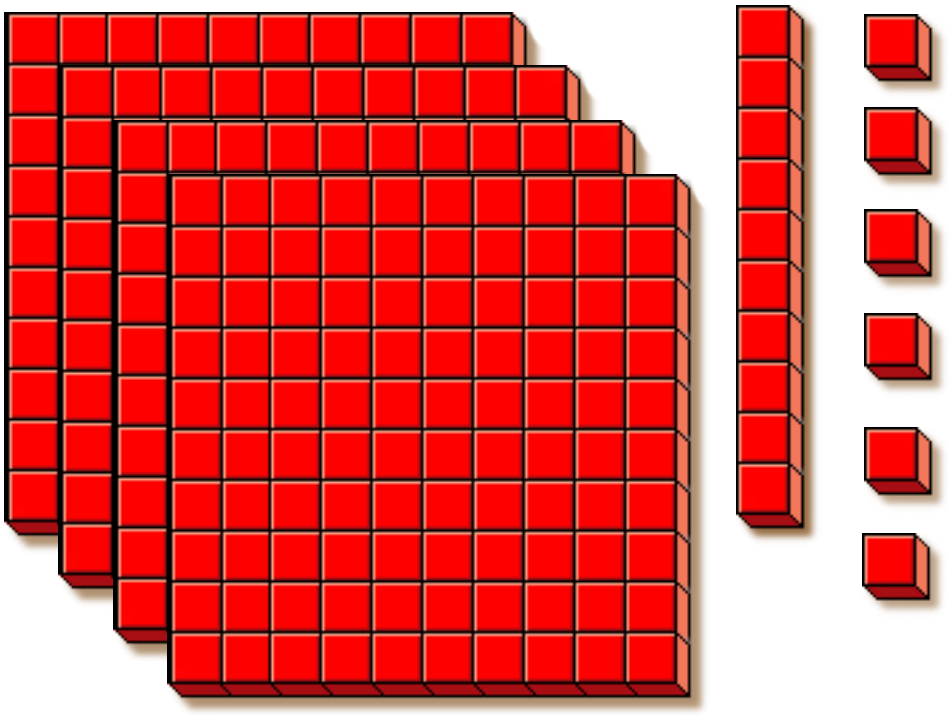


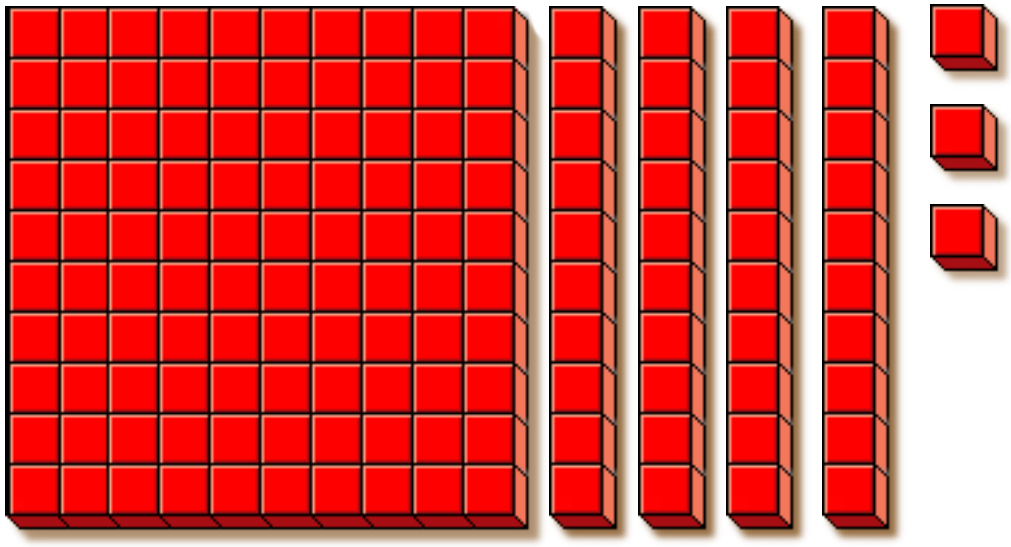
Place Value: Naming Numbers

C.

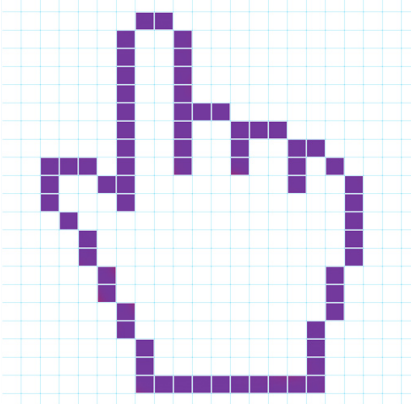


416

D.



143

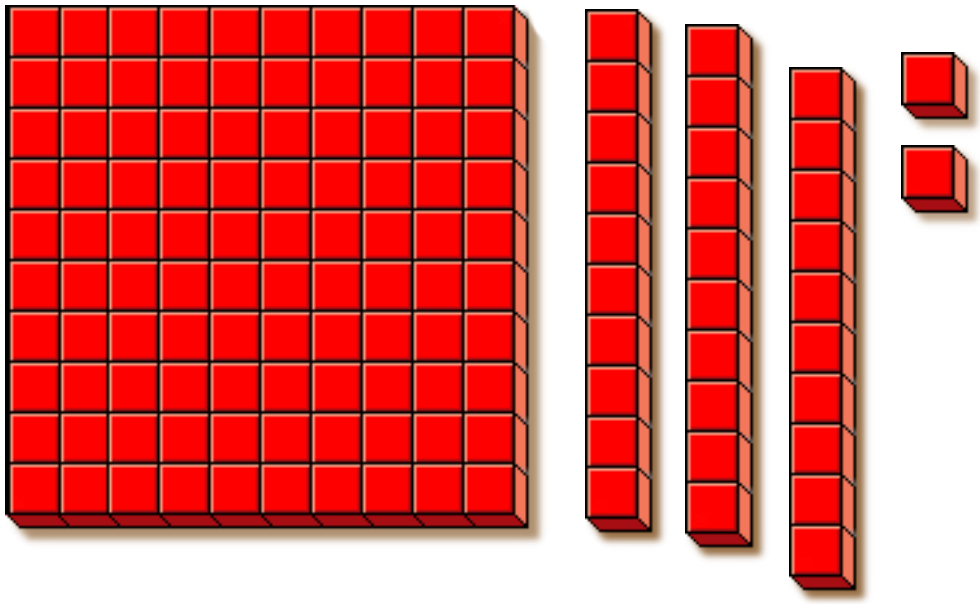


Place Value: Showing Numbers with Blocks

3. Show a given number with Base Ten Blocks.

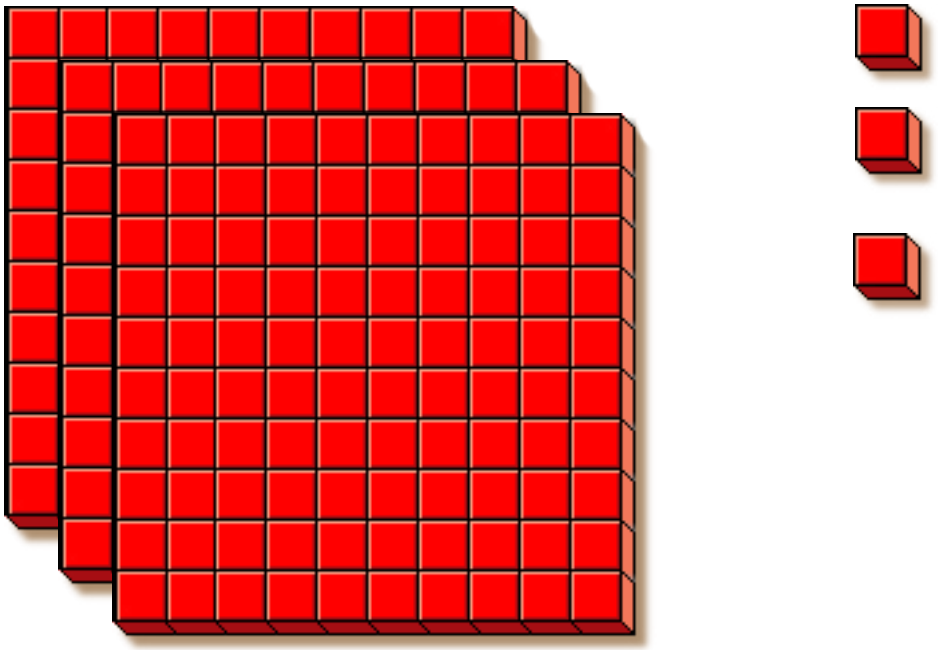
A.

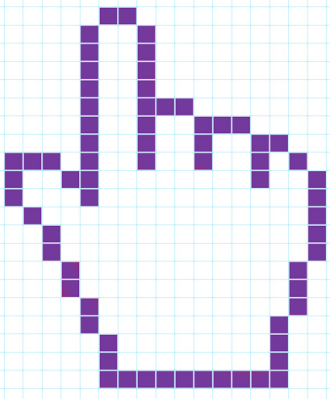
132



B.

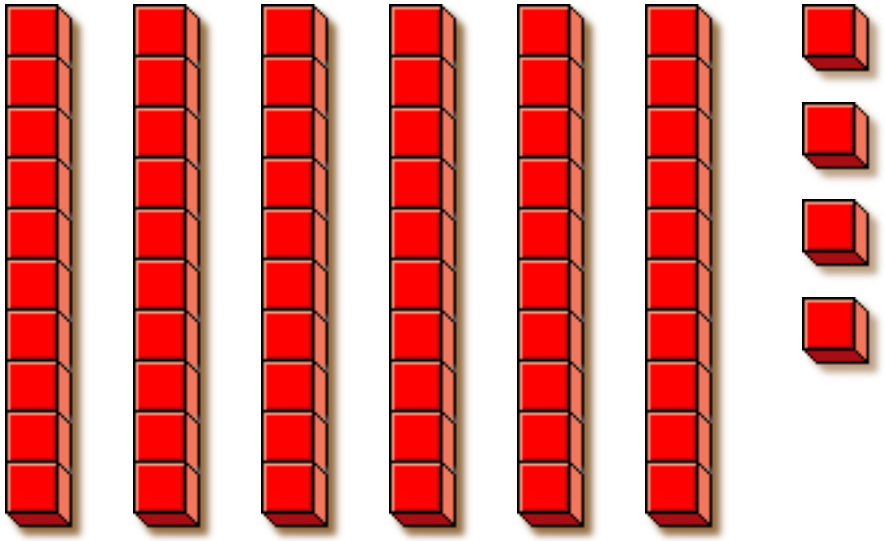
303



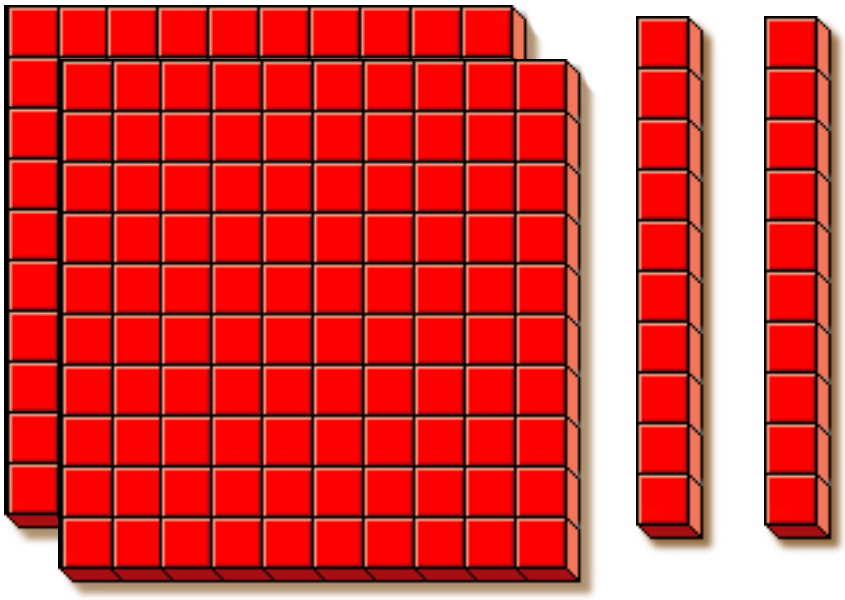


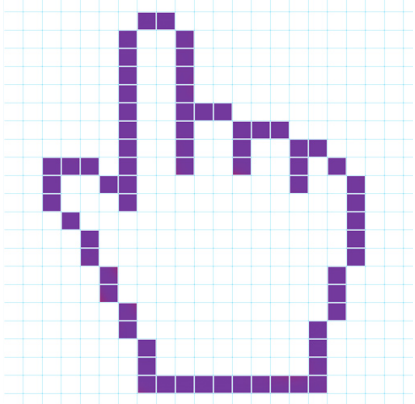
Place Value: Showing Numbers with Blocks

C. 64



D. 220





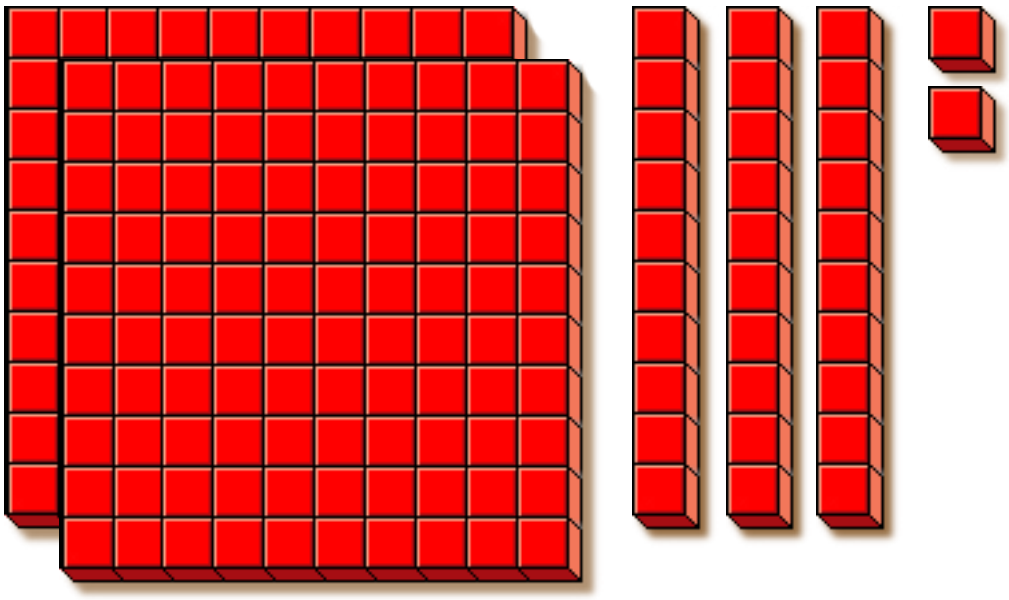
Place Value: Reading Numbers

Set the 'Write Numbers' option to ON.

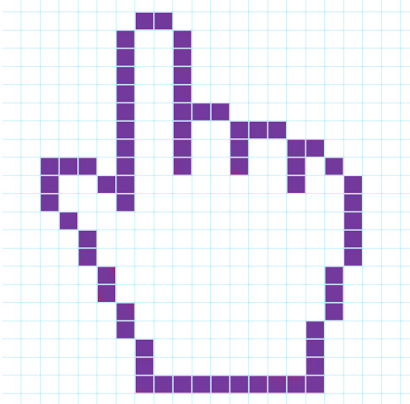
Write Numbers

Show these numbers using the Base Ten Blocks Playground.

Example: Two hundred thirty-two.



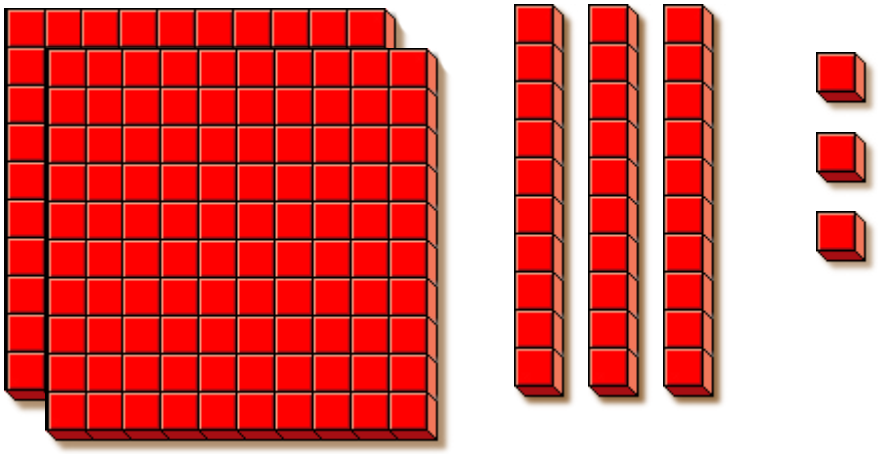
1. One hundred thirty-five.
2. Three hundred seven.
3. Six hundred twenty-three.
4. Five hundred twelve.
5. Six hundred fifty-seven.
6. Nineteeen.
7. Thirty-five.
8. Three hundred one.
9. Sixty-five.
10. Two hundred ninety-seven.



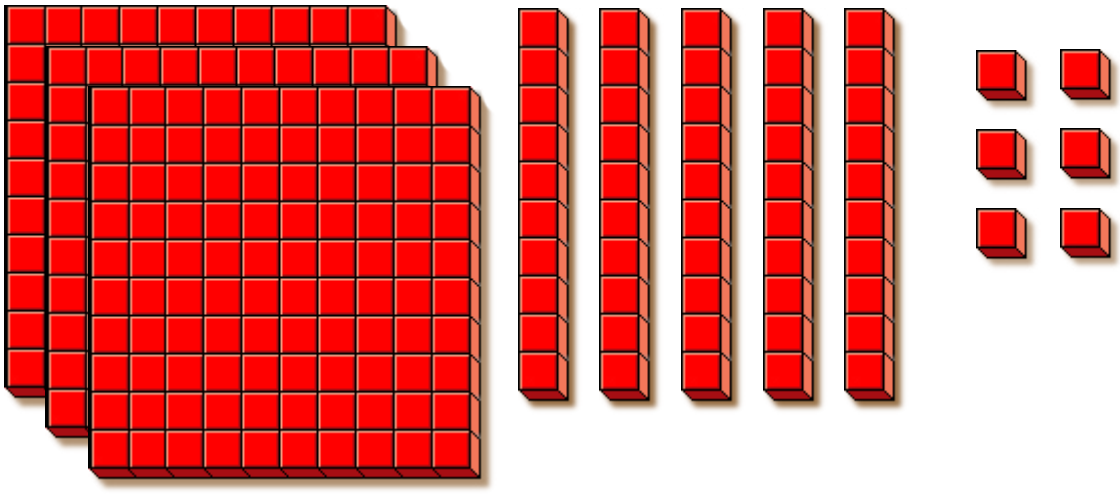
Place Value: Writing Numbers

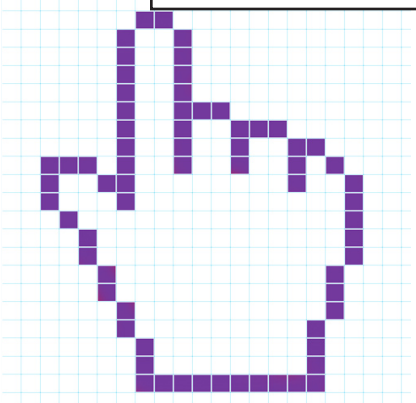
Write in numerals and words the numbers shown with these sets of Base Ten Blocks.

Numerals	*Words*
233	two hundred thirty-three



Numerals	*Words*





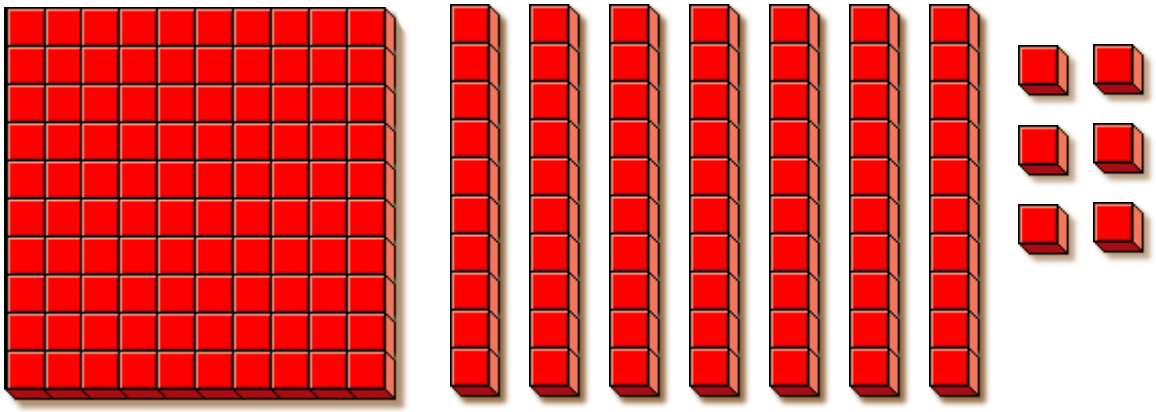
Show these numbers with Base Ten Blocks:

1. Three hundred more than two hundred seventy-eight.
2. One hundred less than three hundred sixty-five.
3. Fifty less than seventy-eight.
4. Twenty-five more than sixteen.

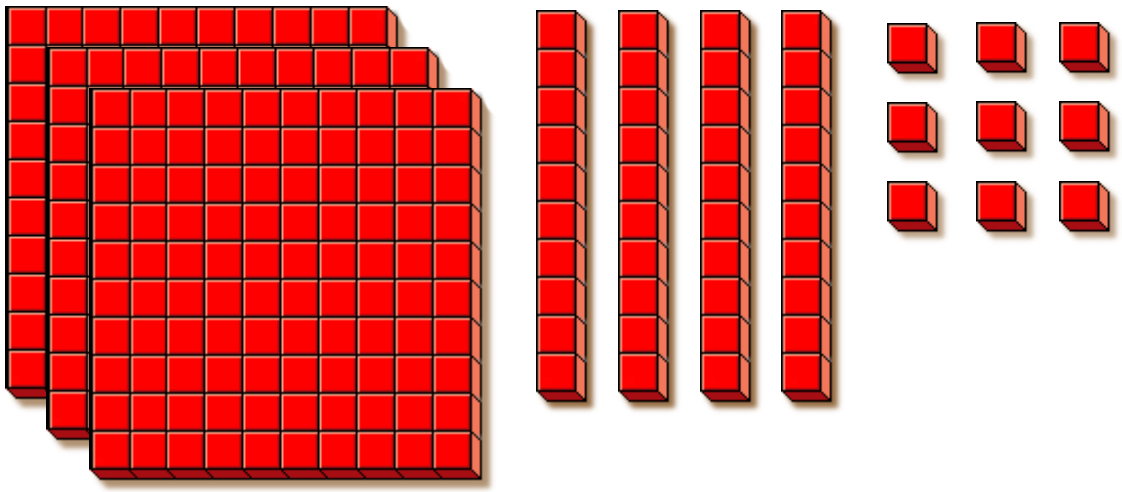
Place Value: Writing Numbers

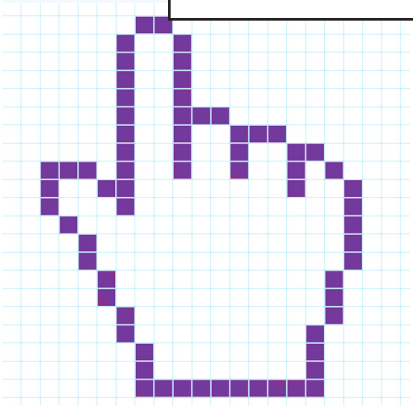
Write in numerals and words the numbers shown with these sets of Base Ten Blocks.

Numerals	*Words*



Numerals	*Words*





Show these numbers with Base Ten Blocks:

1. Five hundred more than one hundred thirty-eight.
2. One hundred less than three hundred sixty-five.
3. Sixty less than seventy-five.
4. Three hundred twenty-five more than twenty-four.

Two-Place Addition

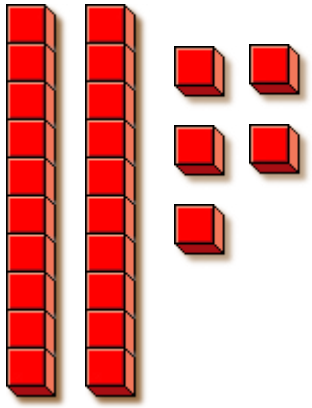
(no regrouping)

Use the Base Ten Blocks Playground to find the sum.

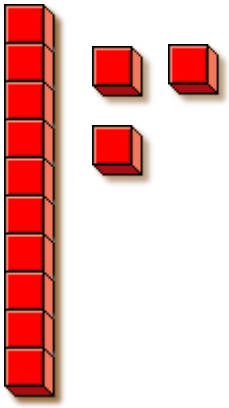
$$\begin{array}{r} 25 \\ +13 \\ \hline \end{array}$$

Steps:

1. Place two tens and five ones on the playground.



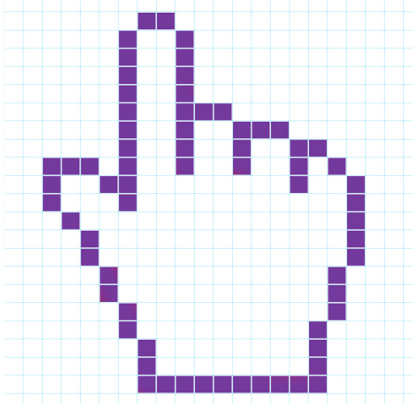
2. Add one ten and three ones.



3. Write the problem and answer in your notebook.

Find the sum.

1. $\begin{array}{r} 65 \\ +12 \\ \hline \end{array}$	2. $\begin{array}{r} 43 \\ +22 \\ \hline \end{array}$	3. $\begin{array}{r} 51 \\ +18 \\ \hline \end{array}$
4. $\begin{array}{r} 53 \\ +22 \\ \hline \end{array}$	5. $\begin{array}{r} 66 \\ +11 \\ \hline \end{array}$	6. $\begin{array}{r} 25 \\ +12 \\ \hline \end{array}$

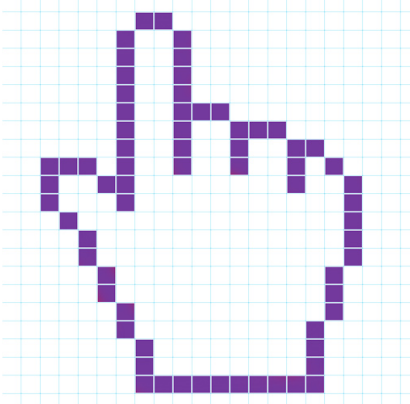


Three-Place Addition
(no regrouping)

Use the Base Ten Blocks Playground to find the sum.

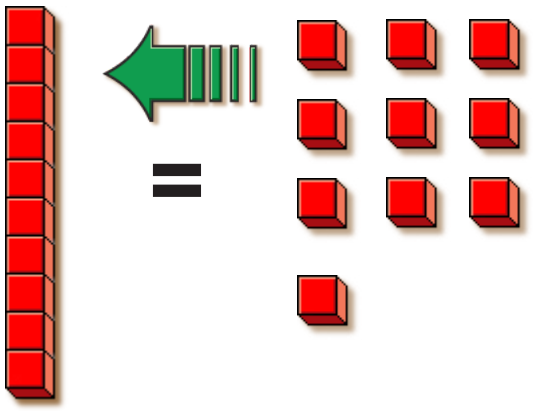
Find the sum.

1. 145 +32	2. 233 +22	3. 101 +18
4. 142 +24	5. 123 +12	6. 125 +12
7. 314 +25	8. 130 +22	9. 185 +12
10. 266 +21	11. 137 +12	12. 310 +27



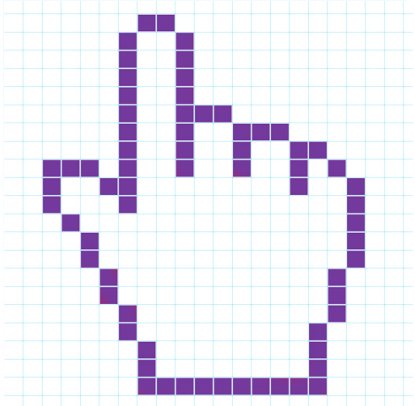
Two-Place Addition
(with regrouping)

Use the Base Ten Blocks Playground to learn about regrouping. Whenever the blocks in a column can be regrouped a green arrow is shown on the screen.



Find the sum.

1. 65 +28	2. 45 +36	3. 23 +18
4. 25 +25	5. 18 +14	6. 25 +18
7. 19 +35	8. 18 +17	9. 35 +17

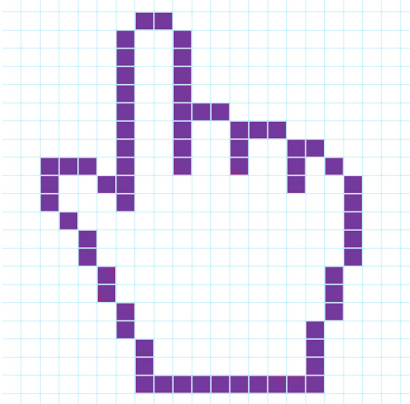


Three-Place Addition
(with regrouping)

Use the Base Ten Blocks Playground to find the sum.

Find the sum.

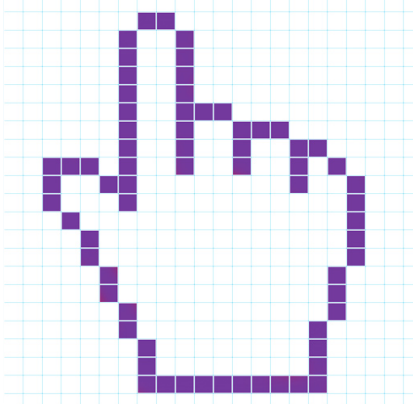
1. 185 +32	2. 239 +42	3. 107 +38
4. 476 +27	5. 188 +16	6. 329 +12
7. 364 +65	8. 390 +25	9. 185 +19
10. 266 +21	11. 137 +12	12. 310 +27



Regrouping (Yes or No)

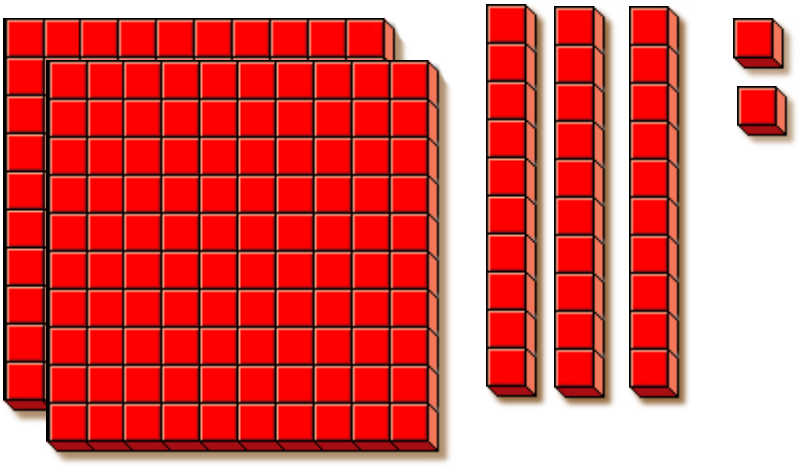
Study each problem. Circle Yes or No to tell if regrouping is needed to find the sum.

1. 125 +32 Regroup Yes No	2. 239 +42 Regroup Yes No	3. 107 +32 Regroup Yes No
4. 426 +87 Regroup Yes No	5. 138 +19 Regroup Yes No	6. 329 +92 Regroup Yes No
7. 344 +75 Regroup Yes No	8. 320 +29 Regroup Yes No	9. 135 +18 Regroup Yes No
10. 226 +26 Regroup Yes No	11. 147 +17 Regroup Yes No	12. 330 +27 Regroup Yes No



Writing Numbers in Expanded Notation

On the Hands-On Math: Base Ten Blocks Playground numbers can be written in either words or expanded notation. In Settings turn the Write Numbers switch to ON. In the Playground tap to switch from written numbers to expanded notation.

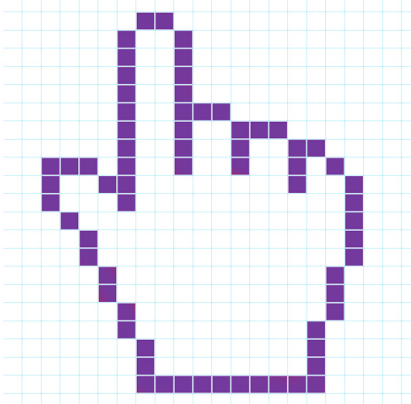


Standard Form *Expanded Notation*

$$232 = 2 \times 100 + 3 \times 10 + 2 \times 1$$

Write these numbers in expanded notation:

Standard	Expanded Notation
367	
125	
421	
555	
62	
197	
185	
150	
925	
32	



Two-Place Subtraction

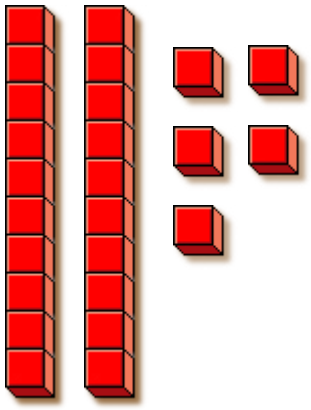
(no regrouping)

Use the Base Ten Blocks Playground to find the difference.

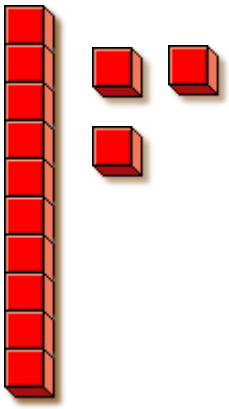
$$\begin{array}{r} 25 \\ -13 \\ \hline \end{array}$$

Steps:

1. Place two tens and five ones on the playground.



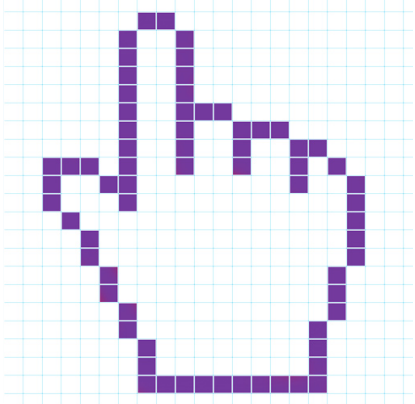
2. Remove one ten and three ones.



3. Write the problem and answer in your notebook.

Find the difference.

1. $\begin{array}{r} 65 \\ -12 \\ \hline \end{array}$	2. $\begin{array}{r} 43 \\ -22 \\ \hline \end{array}$	3. $\begin{array}{r} 51 \\ -11 \\ \hline \end{array}$
4. $\begin{array}{r} 53 \\ -22 \\ \hline \end{array}$	5. $\begin{array}{r} 66 \\ -11 \\ \hline \end{array}$	6. $\begin{array}{r} 25 \\ -12 \\ \hline \end{array}$

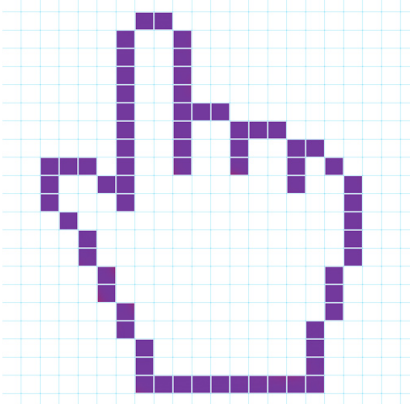


Three-Place Subtraction
(no regrouping)

Use the Base Ten Blocks Playground to find the difference.

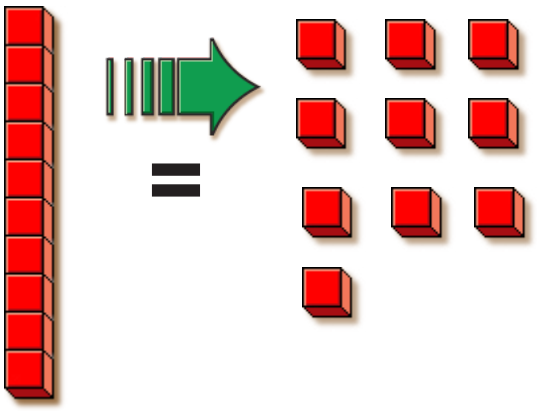
Find the difference.

1. 145 - 32	2. 233 - 22	3. 108 - 11
4. 146 - 22	5. 123 - 12	6. 125 - 12
7. 319 - 25	8. 137 - 22	9. 185 - 12
10. 266 - 21	11. 137 - 12	12. 317 - 20



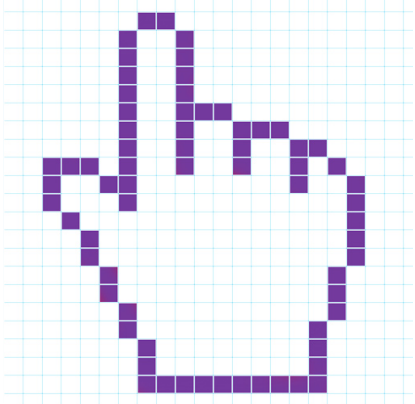
Two-Place Subtraction
(with regrouping)

Use the Base Ten Blocks Playground to learn about regrouping. To exchange a tens block to ones block drag a tens block to the ones column.



Find the sum.

1. 65 − 28	2. 45 − 36	3. 23 − 18
4. 35 − 28	5. 18 − 14	6. 75 − 18
7. 90 − 35	8. 58 − 19	9. 35 − 17

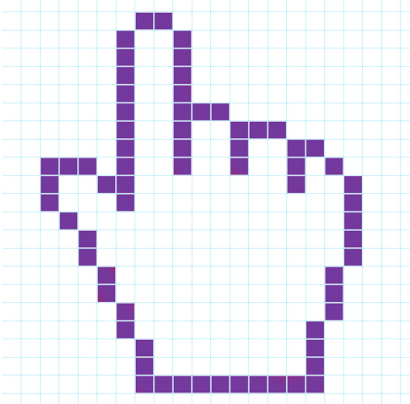


Three-Place Subtraction
(with regrouping)

Use the Base Ten Blocks Playground to find the difference.

Find the difference.

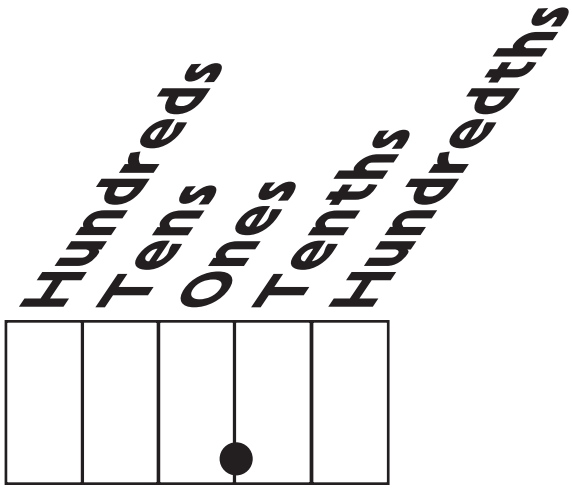
1. 185 − 39	2. 239 − 49	3. 107 − 38
4. 476 − 27	5. 188 − 79	6. 329 − 52
7. 364 − 69	8. 390 − 25	9. 185 − 19
10. 266 − 29	11. 137 − 46	12. 310 − 27



The Meaning of Decimal Places

Use the Setting Control to designate one decimal place for the activities on this page.

The Base Ten Number System is a positional or place value system. The value of a digit is determined by its position in relation to the decimal point. Every number has a decimal point, but some times it is not shown.



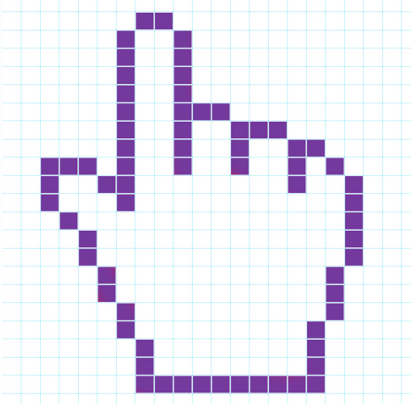
The tenths place is used to represent a fractional part of one. The unit is divided into 10 equal parts. Likewise the hundredths place represents the unit divided into 100 equal parts.

Moving to the left, each position is ten times the previous position. Moving to the right the value of each position is one-tenth of the previous position.

123.45

In this example, the 1 represents 1 hundred. The 2 represents 2 tens. The 3 represents 3 units (or ones). The 4 represents a fractional part of the unit. It is a numerator with a denominator of 10. The 5 is also a fractional part of the unit. It represent the numerator with a denominator of 100.

Base Ten Blocks are a very helpful way to make representations of decimals. Using them is a way to develop mental images of numbers, place value, and operations. Practice representing decimals using the Base Ten Blocks Playground.



1. **25.3**	2. **18.8**	3. **22.3**
2. **15.9**	5. **78.6**	6. **33.3**
7. **28.5**	8. **15.2**	9. **15.9**

Blocks for Learning about Decimals

The unit block changes based on the decimal setting.

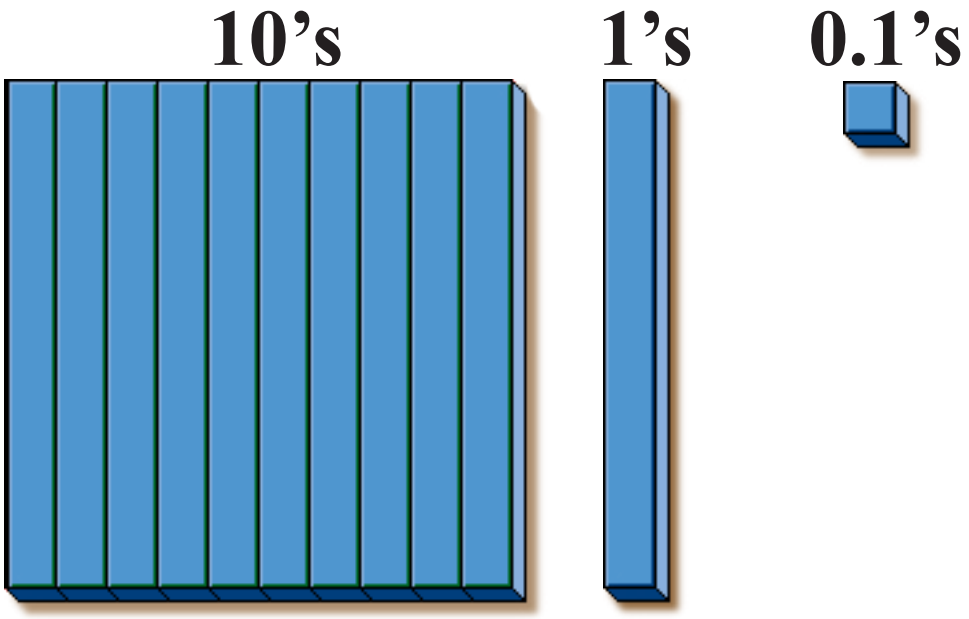
= 1

= 0.1

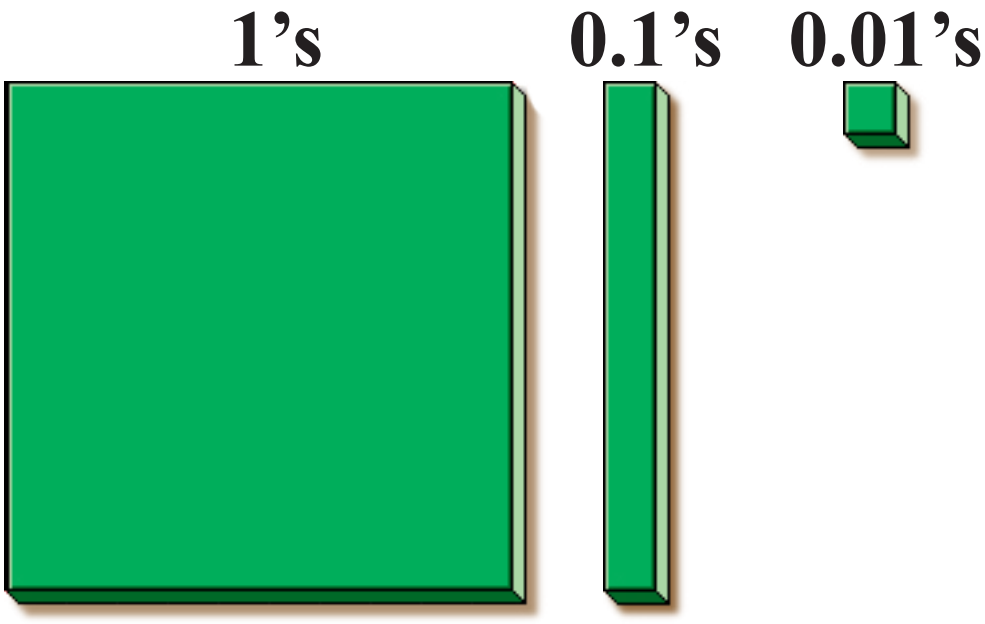
= 0.01

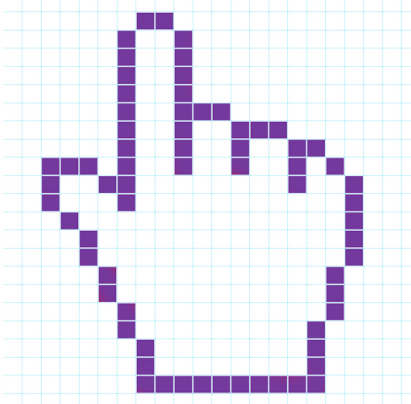
Hands-On Math: Base Ten Blocks has three settings for the number of decimal places.

Use the slider control to set the number of decimal places that are appropriate for your lesson plan. When the setting is at 1 decimal place blue blocks are used on the playground. The blocks values are as shown below:



When the slider control is set to 2 decimal places, green blocks are used to represent ones, tenths, and hudredths.





Adding Numbers with One Decimal Place

(with regrouping)

Base blocks are beneficial for illustrating grouping rules. Ask students to explain the rule that determines place value. For example, if there are 15 blocks 0.1 column, you must regroup to make a 1 by clicking on the green arrow.

For this activity set the number of decimal places to 1.

Use Base Ten Blocks to find the answer to these problems.

1. 9.3 + 3.5 =

2. 2.8 + 1.9 =

3. 3.5 + 1.0 =

4. 2.4 + 1.5 =

5. 2.7 + 2.5 =

6. 4.5 + 2.2 =

7. 3.3 + 2.5 =

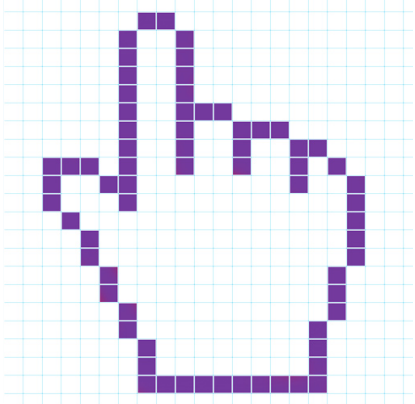
8. 4.3 + 2.4 =

9. 2.5 + 2.0 =

10. 4.6 + 3.8 =

11. 5.6 + 1.8 =

12. 3.5 + 1.4 =



Subtracting Numbers with One Decimal Place

(with regrouping)

It is helpful to encourage students to look at the problem to decide if regrouping is needed before they begin subtracting.

For this activity set the number of decimal places to 1.

Use Base Ten Blocks to find the answer to these problems.

1. 9.6 − 3.9

2. 3.8 − 1.9

3. 5.5 + 1.9

4. 3.8 − 1.5

5. 2.7 − 2.5

6. 7.5 − 2.3

7. 4.3 − 2.5

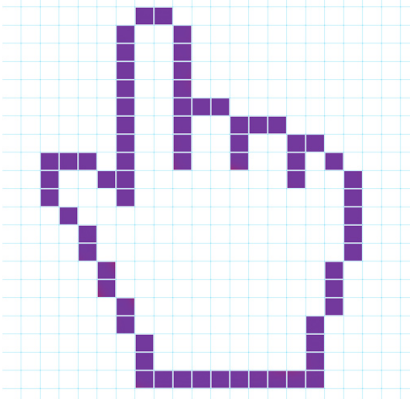
8. 9.3 − 3.4

9. 8.5 − 2.9

10. 6.6 − 3.8

11. 5.6 − 1.8

12. 8.5 − 1.7



Adding Numbers with Two Decimal Places

(with regrouping)

For this activity set the number of decimal places to 2.

Use Base Ten Blocks to find the answer to these problems.

1. 9.63 + 1.35

2. 2.08 + 1.19

3. 3.23 + 1.45

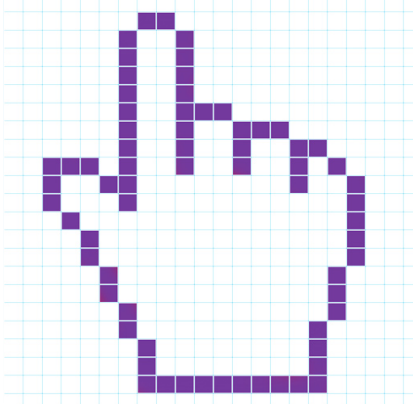
4. 1.28 + 1.39

5. 1.64 + 1.65

6. 3.33 + 6.66

7. 1.38 + 0.25

8. 2.08 + 1.49



Subtracting Numbers with Two Decimal Places

(with regrouping)

It is helpful to encourage students to look at the problem to decide if regrouping is needed before they begin subtracting.

For this activity set the number of decimal places to 2.

Use Base Ten Blocks to find the answer to these problems.

1. 4.03 − 1.35

2. 8.18 − 6.29

3. 3.23 − 1.45

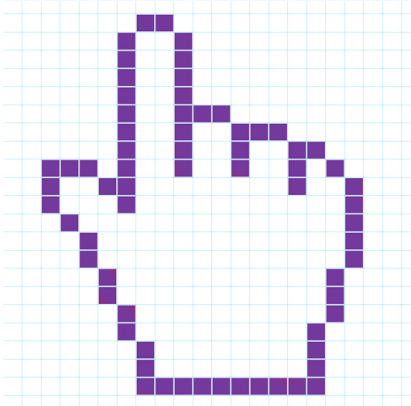
4. 1.28 − 1.39

5. 3.44 − 1.25

6. 8.30 − 1.23

7. 1.38 − 0.28

8. 2.08 − 1.47



Hands-On Math: Base Ten Blocks

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