



AFRICAN INSTITUTE FOR MATHEMATICAL SCIENCES
SCHOOLS ENRICHMENT CENTRE (AIMSSEC)

AIMING HIGH

PLACE VALUE is the theme

for this INCLUSION AND HOME LEARNING GUIDE

This Guide suggests related learning activities for all ages from 4 to 17+

Just choose whatever seems suitable for your group of learners

The DIGIT DETECTIVE activity was designed for Years 4 to 7

DIGIT DETECTIVE

Find the digit to replace the ? mark that makes this equation true:

$$12 + ? = 19$$

Each ? is a missing digit from 0 to 9 either the same or different digits.

$$? + 8 = 2?$$

$$2? + 4 = 1?$$

$$33 + ? = 4?$$

What do you notice?

You are a detective and you have to discover what digits the question marks stand for.

They can be any digit from 0 to 9.

They can be the same digit or different digits.

How will you find the missing digits?

What do you notice?

How many solutions are there to the calculations?

What clues did you use to help you work out your answers?

Explain why this happens?

Now find the missing digits in these calculations. Remember they can be the same or different digits.

(a) $3?6 + 5? = 383$ (b) $8?3 - 7? = 815$

What clues did you use? Explain how you solved the puzzles.

In the next two puzzles each of the digits must be different.

(c) Find the largest possible total for $?? + ?? =$

Explain why it is the largest.

Find the smallest possible total and explain?

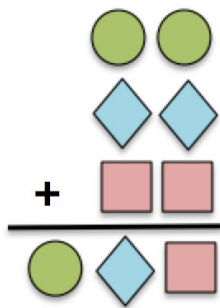
(d) What about $?? \times ??$

(e) Now find the missing digit in this division: $816 \div ? = 272$

HELP

Detectives often work with a partner or a group so you might find it helps to work together with other people on these cases and help each other.

NEXT



Find the Numbers

The 3 symbols, green circle, blue rhombus and pink square, stand for 3 different digits that make the addition sum correct.

Again you need to be a digit detective and find the clues that will help you to solve this puzzle.

<https://aiminghigh.aimssec.ac.za/years-6-7-find-the-numbers/>

INCLUSION AND HOME LEARNING GUIDE

THEME: PLACE VALUE

Early Years and Lower Primary- FIND THE NUMBERS

You are number detectives.

Play a game of **FIND THE NUMBERS**.

How many numbers can you and the children find?

Here are some questions to ask and to talk about.

This is not just an activity for one day, but rather something to do often when the occasion arises.

Look in the street. Look around your house.

What are the numbers for?

This is the number 29 bus that I used to catch every day to go to school in Wood Green.

What if I had got on a bus with a different number?

When I go home should I catch the bus number 92?

Why do vehicles like buses and cars have number plates?

Who can find the most interesting numbers?

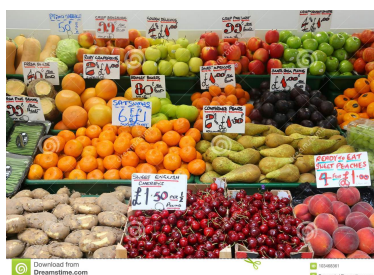
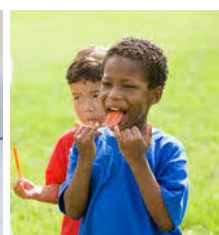
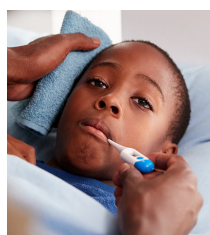
Find more numbers: - telephone numbers, numbers on coins, clocks, packets of food in the kitchen...

What do these numbers tell you?

How are numbers used to tell you that it's a hot day, or a cold one?

What about telling you that you have a fever and are not well?

How are they used for telling how hot an oven is for cooking?



How do numbers tell you about prices in shops?

What dates mean something special - your birthday, Christmas Day or Eid.

What are your own special numbers? Your age, your height, your house number, number of people in your family...

Why are numbers important?

How do we give other people information by using numbers?

How are numbers used to store information?

Draw some pictures that show numbers and what those numbers tell you.

Diagnostic Assessment for years 4 to 7 This should take about 5–10 minutes.

Write the question on the board, say to the class:

“Put up 1 finger if you think the answer is A, 2 fingers for B, 3 fingers for C and 4 for D”.

1 3 4
+ ★8

1 9 2

What number needs to replace the star to make the sum true?

A 5 B 4
C 6 D 1

1. Notice how the learners respond. Ask a learner who gave answer A to explain why he or she gave that answer and DO NOT say whether it is right or wrong but simply thank the learner for giving the answer.
2. It is important for learners to explain the reason for their answer to help them to develop their communication skills and also because by having to put thoughts into words we often clarify our own thinking.
3. Then do the same for answers B, C and D. Try to make sure that learners listen to these reasons and try to decide if their own answer was right or wrong.

4. Ask the class to vote again for the right answer by putting up 1, 2, 3 or 4 fingers. Notice if there is a change and who gave right and wrong answers.

5. The concept is needed for the lesson to follow, so explain the right answer or give a remedial task.

The correct answer is A because $134 + 58 = 192$.

<https://diagnosticquestions.com>

Upper Primary and Lower Secondary

Resources: Copies of the worksheet on page 1 or write the questions on a board or large sheet of paper.

Start with the diagnostic quiz as a warm up.

Then introduce the question (about 5 to 10 minutes). Tell the learners that they are going to be digit detectives and they have to look for clues and solve some puzzles. Ask “*What is the difference between a digit and a number?*”

Tell the learners that they will start with simple calculations so they should find it easy to explain their ways of thinking about the problems.

Write $12 + ? = 19$ on the board. Explain that the question mark ? is a missing digit between 0 and 9

Ask “How will you find the missing digit?” If you have a group of home-learners share your methods with each other, explain how you found the answers:

- Counting on from 12 to 19
- Just knew the answer
- Subtracting 12 from 19. *Why?*
- Because $2 + 7 = 9$
- Some other method.

Write $??? + 150 = 257$ and $? + 8 = ?4$ on the board. If possible the learners should work with a partner or small group to solve these puzzles and to jot down how they worked them out. Then share the strategies. Ask “Where did you start? Why?”

Main part of lesson:

Give out the worksheet copied from page 1 or write the questions on the board.

Paired work (about 10 minutes) Ask the learners to work in pairs and solve the puzzles up to and including (a) and (b) and to make notes of the clues they used to find the solutions. Learners who finish could make up similar problems and swap with their partner.

Group sharing (about 10 to 15 minutes). If you have one learner at home than just talk together. You are **not** trying to teach facts or methods. You should be both trying to find explanations.

Why is it you could not find the digits in $? + 8 = 2?$

What about $2? + 4 = 1?$.

How many solutions did you find to $33 + ? = 4?$

Why is there more than one solution? How could you check you found all the solution?

Share ideas about both $3?6 + 5? = 383$ and $8?3 - 7? = 815$.

Some learners may have used trial and improvement and others may have used their knowledge of place value. Talk about why it helps to start with the units digits then moving on to the tens.

Paired work sharing (about 15 minutes) Tell the learners to do (c), (d) and (e) and make sure that they know that each ? must represent a different digit.

Group sharing (about 10 to 15 minutes)

Ask “How can you be sure that $97 + 86$ and $96 + 87$ are the largest possible numbers?”

Ask “How can you be sure that $13 + 20$ and $10 + 23$ are the smallest possible numbers?”

“Why will it make a difference if you change over the tens and units digits?”

What about the smallest number?

“What digits did you use?”

Why can't 0 be in the tens place?”

Share solutions and strategies for $?? \times ??$ and discuss maximum and minimum values.

Ask how they solved the puzzle : $816 \div ? = 272$ and discuss inverse operations.

Key questions

- What do you notice?
- How many solutions are there to the calculations?
- What clues did you use to help you work out your answers?
- Can you explain how you solved the puzzles?
- Can you explain why this happens?
- What other combinations did you try?
- What ideas did you use?

SOLUTION

? + 8 = 2? is impossible.

There are no solutions because the largest number you can get from $? + 8 = 9 + 8 = 17$ which is less than 20.

2? + 4 = 1? is impossible.

There are no solutions because 2? has to be at least 20 and by adding 4 you get a number greater than 20.

33 + ? = 4? has 3 solutions.

You do not get a solution if you add any digit less than 7 to 33 because you get an answer less than 40.

$$33 + 7 = 40$$

$$34 + 8 = 41$$

$$35 + 9 = 42$$

(a) 3?6 + 5? = 383 has the solution

$$326 + 57 = 383$$

The clues are that to get the units digit 3 you must add 7 to 6.

Then $7 + 6 = 13$ so you are looking for $1 + 5 + ? = 8$ to find the tens digit.

(b) 8?3 - 7? = 815 has the solutions

$$893 - 78 = 815$$

The clues are that you must subtract a number from 13 to get the units digit 5.

The inverse operation $815 + 78$ gives the number 893.

(c) The largest total for $?? + ?? =$ is

$$97 + 86 = 183 \text{ or}$$

$$96 + 87 = 183$$

To get the largest total you need to make the tens digits as large as possible and then make the units digits as large as possible choosing from the remaining digits.

The smallest is

$$10 + 23 = 33 \text{ or}$$

$$13 + 20 = 33$$

(d) The largest product for $?? \times ??$

is $96 \times 87 = 8352$.

This is bigger than $97 \times 86 = 8342$

To get the largest product we have to multiply the largest units digit by the largest tens digit as shown by the grid method of multiplication.

We see that

$$480 + 630 = 1110$$

but

$$560 + 540 = 1100$$

\times	90	6	
80	7200	480	7680
7	630	42	672
	7830	522	8352

\times	90	7	
80	7200	560	7760
6	540	42	582
	7740	602	8342

Similarly $10 \times 23 = 230$ which is smaller than $13 \times 20 = 260$.

(e) The missing digit is 3 in this division:

$$816 \div ? = 272$$

$$816 \div 3 = 272$$

Why do this activity?

This activity develops a deeper understanding of place value and inverse operations by challenging learners to act as detectives and to solve number puzzles. They get practice in calculations in what seems to be a game. By asking for reasons for what they do to solve the puzzles, the aim is to develop the sense of number size and mathematical thinking. Learners share ideas about their intuitive methods in simple addition and subtraction problems. They handle problems with no solutions and with multiple solutions and progress to problems including multiplication and division.

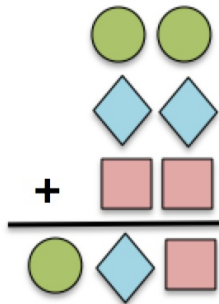
Learning objectives

This activity aims to help learners to develop:

- A deeper understanding of place value.
- An understanding of inverse operations and that the word 'inverse' means 'undo'.
- A feel for the size of numbers leading to understanding of maximum and minimum values.
- Mathematical thinking and communication skills.

Upper Secondary

Work through the problems on page 1 then solve:



Find the Numbers

The 3 symbols, green circle, blue rhombus and pink square, stand for 3 different digits that make the addition sum correct.

Again you need to be a digit detective and find the clues that will help you to solve this puzzle.

If you find that one easy then try FOOTBALL CHALLENGE

<https://aiminghigh.aimssec.ac.za/years-7-12-football-challenge/>

Generic competences

In doing this activity students will have an opportunity to:

1. **think mathematically**, reason logically and give explanations;
2. **think flexibly**, be creative and innovative - to apply knowledge and skills;
3. **research**, search for, analyse, and interpret information.

Follow up

Find the Numbers <https://aiminghigh.aimssec.ac.za/years-6-7-find-the-numbers/>

Football Challenge <https://aiminghigh.aimssec.ac.za/years-7-12-football-challenge/>



Go to the **AIMSSEC AIMING HIGH** website for lesson ideas, solutions and curriculum links: <http://aiminghigh.aimssec.ac.za>

Subscribe to the **MATHS TOYS YouTube Channel**

<https://www.youtube.com/c/mathstoys>

Download the whole AIMSSEC collection of resources to use offline with the AIMSSEC App see <https://aimssec.app> Find the App on Google Play.

Note: The Grades or School Years specified on the AIMING HIGH Website correspond to Grades 4 to 12 in South Africa and the USA, to Years 4 to 12 in the UK and school years up to Secondary 5 in East Africa.

New material will be added for Secondary 6.

For resources for teaching A level mathematics (Years 12 and 13) see <https://nrich.maths.org/12339>

Mathematics taught in Year 13 (UK) & Secondary 6 (East Africa) is beyond the SA CAPS curriculum for Grade 12

	Lower Primary Approx. Age 5 to 8	Upper Primary Age 8 to 11	Lower Secondary Age 11 to 15	Upper Secondary Age 15+
South Africa	Grades R and 1 to 3	Grades 4 to 6	Grades 7 to 9	Grades 10 to 12
East Africa	Nursery and Primary 1 to 3	Primary 4 to 6	Secondary 1 to 3	Secondary 4 to 6
USA	Kindergarten and G1 to 3	Grades 4 to 6	Grades 7 to 9	Grades 10 to 12