

AFRICAN INSTITUTE FOR MATHEMATICAL SCIENCES SCHOOLS ENRICHMENT CENTRE (AIMSSEC) AIMING HIGH

This INCLUSION AND HOME LEARNING GUIDE suggests related learning activities for all ages from 4 to 18 on the theme of POSITIVE AND NEGATIVE

Choose what seems suitable for the age or attainment level of your learners

The original UP AND DOWN GAME was designed for Years 7 to 9

UP DOWN GAME

-9	-8	-7	+3	+4	+5
-6	-5	-4	+6	+7	+8
-3	-2	-1	+9	+10	+
0	+1	+2	+	-	_

This is a game for 2 players, or a group of 3 or 4 players, or for the whole family. You will need to print and cut out 2 sets of these 24 cards.

Separate the 40 number cards from the 8 operation cards and shuffle them separately to mix them up.

With two players or a small group each player is dealt 3 number cards and 2 operation cards and has to rearrange them to get the highest positive

number. This can be played with a timer. The player who gets the highest number wins one point. If two or more players get the same highest number each player gets a point.

The first player to reach 10 points is the winner.

HELP

You could start with a few rounds of the much simpler game using 2 number cards and 1 operation

NEXT

You could introduce multiplication \times and/or division $\div.$

+3	+4	+5
+6	+7	+8
+9	+10	╉

INCLUSION AND HOME LEARNING GUIDE THEME: POSITIVE AND NEGATIVE

Early Years

FORWARD & BACK RACE V1 (2 players or 2 teams)

You need an open space outdoors or in a big room and 1 die or a 1-6 spinner. Mark out a starting line and a finishing line for the race that measures 20 paces for the smallest person playing. The bigger people need pencil and paper so they can record their position after each round of the game.



Explain the rules of the game. The best way to do this is to have several trial games and explain the rules as you go along. Do this until everyone understands exactly how the game works and what they must do. Then play the game competitively. Note that you could have more teams (or the players could all play as individuals) but it's better as a game for 2 because it's more exciting. With say 10 individuals, there have to be 20 throws for each round and a lot of waiting for your next turn. With 2 teams, of 5 people in each team, the game moves along much faster.

<u>RULES</u>

- Everyone lines up along the starting line, Team A on the left and Team B on the right. Alternatively (especially if there is not much space, or if you are playing the game online) one representative of each team can stand on the starting line and move FORWARD and BACK and the rest of the players watch.
- 2. The organiser throws the die or spins for the first player or team, and calls out the number giving the number of paces. The numbers 2, 4 or 6 on the second throw gives FORWARD and 1, 3 or 5 on the second throw gives BACK. So if the numbers are 5 first and then 3, player A goes BACK 5 paces.
- 3. The organiser repeats the throws for player B. If, for example, the first throw is 2 this time and the second is 6 then player B goes FORWARD 2 paces.
- 4. The first player to cross the finishing line (20 paces) is the winner.

To make it a fair game you must use the distance to be 20 paces for the smallest player so they don't have to keep count of their 'scoring position' except to count the number of steps they take. Once they have learnt the game the little people should know that there is no advantage in taking huge strides forward to get over the finishing line in 19 strides, and no point in little steps back, because someone is keeping count of how many paces they go each way. Older players should take small steps to 'get there' in 20 rather than striding out, and they should keep record of where they are after each round.

The game is short and it's fun. Playing the game often will lay an important mathematical foundation stone. It will give your children a basic understanding of direction which will later help them to understand negative numbers and calculations with negative numbers.

Lower Primary FORWARD & BACK RACE V2 (2 players or 2 teams)

You need an open space outdoors or in a big room and 2 dice of different colours or a 1-6 spinner (but you can play with 1 die and throw it twice as described in the Early Years version of the game). Mark out a starting line and a finishing line for the race that measures 20 paces for the smallest person playing. The bigger people need pencil and paper so they can record their position after each round of the game.

Explain the rules of the game. The best way to do this is to have several trial games and explain the rules as you go along. Do this until everyone understands exactly how the game works and what they must do. Then play the game competitively. Note that you could have more teams (or the players could all play as individuals) but it's better as a game for 2 because it's more exciting. With say 10 individuals, there have to be 20 throws for each round and a lot of waiting for your next turn. With 2 teams, of 5

people in each team, the game moves along much faster.

<u>RULES</u>

1. Everyone lines up along the starting line, Team A on the left and Team B on the right. Alternatively (especially if

there is not much space, or if you are playing the game online) one representative of each team can stand on the starting line and move FORWARD and BACK and the rest of the players watch.

- 2. The number on the blue die gives the number of paces FORWARD and the number on the red die gives the number of paces BACK.
- 3. The organiser throws the dice or spins for the first player or team, and calls out the numbers giving the number of paces FORWARD of BACK. So if the numbers are 5 blue 6 red (as shown) the player goes 1 step BACK. Either the player can take 5 steps forward then 6 steps back or work it out mentally and just take 1 step back.
- 4. The organiser repeats the throws for player B ending the round, and throws again for the second round.
- 5. The first player to cross the finishing line (20 paces) is the winner.

To make it a fair game you must use the distance to be 20 paces for the smallest player so they don't have to keep count of their 'scoring position' except to count the number of steps they take. Once they have learnt the game the little people should know that there is no advantage in taking huge strides forward to get over the finishing line in 19 strides, and no point in little steps back, because someone is keeping count of how many paces they go each way. Older players should take small steps to 'get there' in 20 rather than striding out, and they should keep record of where they are after each round.





As with the V1 version of this game for Early Years, this version of the game is short and it's fun. Playing the game often will lay important mathematical foundation stones. It will give your children a basic understanding of direction and also it will build a concept of 2 colours for 2 types of number, blue for positive and red for negative which will later help them to understand negative numbers and calculations with negative numbers. (see https://en.wikipedia.org/wiki/Negative_number)

Introduce the idea of UP and DOWN instead of FORWARD and BACK and show the learners this picture of the control buttons on an elevator (lift). These buttons give the destination not the number of steps to get there so you press the -1 button if you want to go to the basement level minus 1.

You could make up your own ELEVATOR GAME . Image you are on a particular floor in this building and calculate how many floors you have to go up or down to your destination. This is The Carlton Centre Johannesburg with 50 floors. At 223 metres tall, it's the 2nd tallest building in Africa and it goes down 15 metres below ground level.





Upper Primary FORWARD & BACK RACE V3 (2 players or 2 teams)

Start by playing the VI and V2 versions of this game as described for early Years and Lower Primary.

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20

FORWARD AND BACK RACE ON THE NUMBER LINE - VERSION 3

You need an open space outdoors or in a big room and 2 dice of different colours or a 1-6 spinner (but you can play with 1 die and throw it twice as described in the Early Years version of the game). Mark out a starting line and a finishing line for the race that measures 20 paces for the smallest person playing. The bigger people need pencil and paper so they can record their position after each round of the game.

Explain the rules of the game. The best way is to draw a number line and explain that FORWARD is going towards 20 and BACK is going towards 0. Then have several trial games and explain the rules as you play, and moving a counter on the number line. Do this until everyone understands exactly how the game works and what they must do. Then go out to your space and physically play the game competitively as a PEOPLE MATHS learning activity. Note that you could have more teams (or the players could all play as individuals) but it's better as a game for 2 because it's more exciting. With say 10 individuals, there have to be 20 throws for each round and a lot of waiting for your next turn. With 2 teams, of 5 people in each team, the game moves along much faster.

RULES

- Everyone lines up along the starting line, Team A on the left and Team B on the right. Alternatively (especially if there is not much space, or if you are playing the game online) one representative of each team can stand on the starting line and move FORWARD and BACK and the rest of the players watch.
- The number on the blue die gives the number of paces FORWARD and the number on the red die gives the number of paces BACK.



- 3. The organiser throws the dice or spins for the first player or team, and calls out the numbers giving the number of paces FORWARD of BACK. So if the numbers are 5 blue 6 red (as shown) the player goes 1 step BACK towards zero. Either the player can take 5 steps forward towards 20 then 6 steps back towards 0, or work it out mentally and just take 1 step back.
- 4. The organiser repeats the throws for player B ending the round, and throws again for the second round.
- 5. The first player to cross the finishing line (20 paces) is the winner.

To make it a fair game you must use the distance to be 20 paces for the smallest player so they don't have to keep count of their 'scoring position' except to count the number of steps they take. Once they have learnt the game the little people should know that there is no advantage in taking huge strides forward to get over the finishing line in 19 strides, and no point in little steps back, because someone is keeping count of how many paces they go each way. Taller players should take small steps to 'get there' in 20 rather than striding out, and they should keep record of where they are after each round.

As with the other versions of this game for Early Years and Lower Primary, this version of the game is short and it's fun. Play the game as a PEOPLE MATHS activity and then go back to the classroom and play it with counters on a number line choosing different counters for each player. The whole class can play in 2 teams or, if you have enough dice or spinners, the learners could play the game in pairs.

Playing the game often will lay important mathematical foundation stones. It will begin to build concepts of give your learners a basic understanding of:

- 1. direction on a number line;
- 2. numbers corresponding to points in space (in this case on a number line);
- 3. movement in two directions on a number line, to the right and left;
- 4. 2 colours for 2 types of number, blue for positive and red for negative to help them later to understand negative numbers and calculations with negative numbers.

Talk about APPLICATIONS OF THESE IDEAS IN REAL LIFE.

Play the ELEVATOR GAME as described in the LOWER PRIMARY section.

This thermometer shows a negative Fahrenheit temperature of minus 4. What temperature is the freezing compartment in your fridge? Is it measured in degrees Centigrade or degrees Fahrenheit? Your class might even find out why we have these two scales (scientific, geographic and cultural reasons) for measuring temperature and how you convert from one to the other.



132			≡	
5089			⊥	Ш
- 704		Т		
- 6027	\bot		=	Т

Negative numbers appeared for the first time in history in the <u>Nine Chapters on the</u> <u>Mathematical Art</u>, which in its present form dates from the period of the Chinese <u>Han</u> <u>Dynasty</u> (202 BC – AD 220)

See

https://en.wikipedia.org/wiki/Negative number)

Lower Secondary

Tell the class that the lesson will be about negative numbers. Talk about many applications of negative numbers today, for example in measuring temperatures, sport, lifts in multistorey car parks, accounting and banking, science, engineering and height above sea level and depth below sea level.



Suggestions for home learning

Resources: 2 sets of cards (48 cards) for the group game for a larger group. Or 2 sets of cards for each group of 2, 3 or 4 players.



The balloon suggests an analogy for directed numbers (vectors) with positive numbers going up and negative numbers going down. This is a hot air balloon over the migration of millions of antelope across the Masai Mara in Kenya.

As a game for the whole family (or whole class in school): Use 48 cards as with the game for small groups. Shuffle the cards and deal out 3 number cards and 2 operation cards.

The players should write their calculation and total on a showboard (or piece of paper) as large as possible and hold up their showboards when you say "UP". The players with the largest total score a point after checking.

Game for small groups: The difference between playing in small groups and the whole class game is that, with the whole class all the players have **the same chance of winning** whereas with the small group game the chance of winning each time depends to some extent on **luck and which cards a player is dealt**. This aspect of the games should be discussed by the class as an exercise in thinking about probability.

Key questions

- How could you use the sign to make a bigger number?
- Could you use brackets to make a bigger number?

Pedagogical Note:

It's advisable to be very careful over your use of language. Always use the words 'add' and 'subtract' for the operations of addition and subtraction (never plus and minus) and always use the words 'positive' and 'negative' for the numbers.

It seems that the problems that people have in understanding the use of negative numbers concerns:

- the difference between the *operation* of subtraction and the *object* (a negative number), since the same sign is used for both;
- the language involved like 'minus minus 3' as opposed to 'subtract negative 3';
- separating the physical model or analogy (be it profit/loss or rise/fall in temperature or rotation/direction in the plane) from the rules of operating on the entities.

SOLUTION

For example, using +9, -7 and -5 with the operations – and + , the highest number is: +9 - -7 + -5 = +11

or, if brackets are allowed:

+9 - (-7 + -5) = +21

Why do this activity?

This makes practice in adding and subtracting positive and negative numbers into an enjoyable game.

Learning objectives

In doing this activity students will have an opportunity for practice in adding and subtracting positive and negative numbers

Generic competences

In doing this activity students will have an opportunity to:

- think mathematically, reason logically and give explanations;
- play games competitively following the rules **with consideration for other people**.

Diagnostic Assessment This should take about 5-10 minutes.

Show this question to the learners and say:

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



1. Notice how the learners respond. Ask them to explain, one by one, why they he gave their answers 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 answers. Try to make sure that learners listen to these reasons and try to decide if their own answer was right or wrong.

3. Ask them again to vote 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.

4. This game can serve as a remedial task if the teacher checks all the answers as the game proceeds.

C. is the correct answer.

Common Misconceptions

A., B., D. Learners who give these answers do not understand how to add and subtract integers. <u>https://diagnosticquestions.com</u>

Upper Secondary

Play some of the games described in this Guide with a friend using pencil and paper, or play the games with younger brothers and sisters as a PEOPLE MATHS activity.

Invent your own number game involving the 4 operations of addition, subtraction, multiplication and division and positive and negative rational numbers.

How much do you know about negative numbers and their origins? How confident are you about calculations involving positive and negative numbers?

Read the Wikipedia article: <u>https://en.wikipedia.org/wiki/Negative_number</u>)

Read the Wikipedia article on the History of Banking <u>https://en.wikipedia.org/wiki/History of banking</u>



Follow up

Read the article What are Numbers <u>https://nrich.maths.org/5805</u>

Read the article Making sense of Positives and Negatives <u>https://nrich.maths.org/9958</u> Target game <u>https://aiminghigh.aimssec.ac.za/years-7-10-target-game/</u> Extremes <u>https://aiminghigh.aimssec.ac.za/years-6-10-extremes/</u>



Go to the **AIMSSEC AIMING HIGH** website for lesson ideas, solutions and curriculum links: <u>http://aiminghigh.aimssec.ac.za</u> Subscribe to the **MATHS TOYS YouTube Channel** <u>https://www.youtube.com/c/mathstoys</u> Download the whole AIMSSEC collection of resources to use offline with the AIMSSEC App see <u>https://aimssec.app</u> Find the App on Google Play.