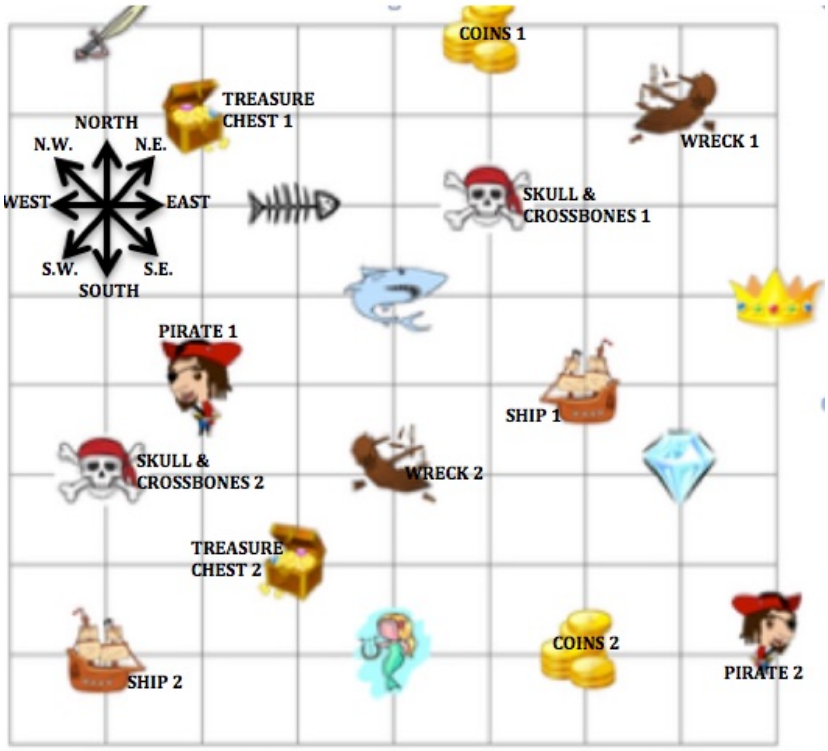
AFRICAN INSTITUTE FOR MATHEMATICAL SCIENCES
SCHOOLS ENRICHMENT CENTRE (AIMSSEC)
AIMING HIGH

UP DOWN LEFT OR RIGHT 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 NAVIGATION activity was designed for Upper Primary & Lower Secondary

NAVIGATION



Pirate 1 sails:
3 squares North,
then diagonally
1 square South East,
2 squares North East,
2 squares South,
1 square South West,
4 squares East
then 4 squares south.

Where does he get to and what does meet on his journey?

Using the 8 compass directions, describe a route for Pirate 2, in which he picks up everything in the picture and returns to his starting point. He refloats the wrecks and all the ships join his fleet.

HELP

In the description of the journey, crossing a square always goes from one corner to another corner of the square. This is either going along one of the edges going North, South, East or West or alternatively going along a diagonal going North East, South East, South West or North West. The distances are not the same because crossing a square from corner to corner is longer than a step along one edge of the square.

NEXT

Create and draw an island with hidden treasure and give instructions for finding the treasure.

INCLUSION AND HOME LEARNING GUIDE

THEME: UP DOWN LEFT OR RIGHT (an introduction to vectors)

Early Years – FORWARD, BACKWARD, RIGHT, LEFT

Play a game of pretending to be robots. Talk about **robots that follow commands**. Tell the children that they are going to pretend to be robots and you are going to give commands, and after a while one of them can give commands instead of you. Tell them they will be like soldiers on a parade ground.

You need space for this activity so that the children can move as 'commanded' so do it outdoors or somewhere where you have space.

Introduce the commands in the list below one by one and practice them.

- **Right turn** (this is a turn by 90° clockwise, but you don't need to use that language with young children).
- **Left turn** (this is a turn by 90° anti-clockwise, but you don't need to use that language with young children).
- **Forward 1 step.**
- **Forward 2 steps etc.**
- **Back 1 step.**
- **Back 2 steps etc**.

Try sequences of commands like:

1. **Forward 3 steps.**
2. **Right turn.**
3. **Forward 4 steps**
4. **Right turn**
5. **Forward 3 steps.**
6. **Right turn.**
7. **Forward 4 steps**
8. **Right turn**

What happens?
What shape did they walk around?
How much did they turn altogether?
Which way were they facing at the start?
Which way were they facing at the end?
Give the same commands but with Left turns instead of right. What happens?

Imagine other shapes and give commands so the robots walk along the edges of the shapes.

Lower Primary – UP, DOWN, RIGHT, LEFT ON A GRID

Play a game of pretending to be robots. Talk about **robots that follow commands**. Tell the children that they are going to pretend to be robots and you are going to give commands, and after a while one of them can give commands instead of you. Tell them they will be like soldiers on a parade ground.

You need space for this activity so that the children can move as 'commanded' so do it outdoors or somewhere where you have space.

Introduce the commands in the list below one by one and practice them.

- **Right turn**

(this is a turn by 90° clockwise, but don't use that language with the children).

- **Left turn**

(this is a turn by 90° anti-clockwise, but don't use that language with the children).

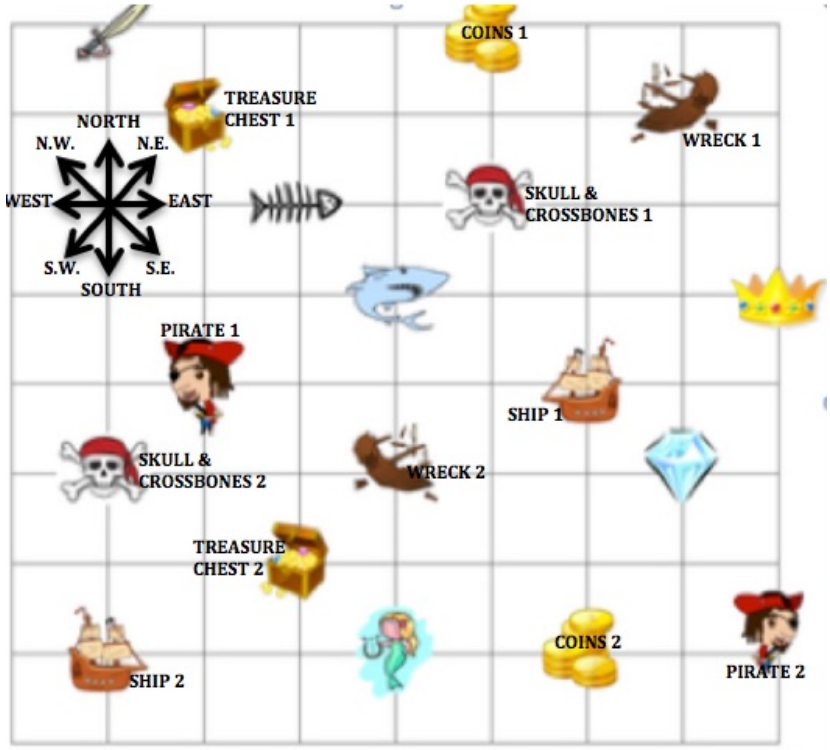
- **Forward 1 step.**
- **Forward 2 steps etc.**
- **Back 1 step.**
- **Back 2 steps etc**.

Try sequences of commands like:

9. **Forward 3 steps.**
10. **Right turn.**
11. **Forward 4 steps**
12. **Right turn**
13. **Forward 3 steps.**
14. **Right turn.**
15. **Forward 4 steps**
16. **Right turn**

What happens?
What shape did they walk around?
How much did they turn altogether?
Which way were they facing at the start?
Which way were they facing at the end?
Give the same commands but with Left turns instead of right. What happens?

Pirate 1 sails along the path:



Forward 1
Left turn
Forward 1
Forward 1
Left turn
Forward 2
Right turn
Forward 1
Left turn
Forward 1
Forward 3
Left turn
Forward 2
Right turn
Forward 1
Right turn
Forward 2

Where does he get to and what does meet on his journey?

Using these commands, describe a route for Pirate 2, in which he picks up everything in the picture and returns to his starting point. He re-floats the wrecks and all the ships join his fleet.

Upper Primary – COMPASS DIRECTIONS

Ideally start outdoors or in a space big enough for learners to move in the 8 compass directions. Discover the North direction and **start with all the learners facing North**. Display a large diagram showing the 8 compass directions. Start with instructions for the learners to obey like: take 2 steps East, take 3 steps South etc. … until the learners are sure about which is which of the directions North, South, East and West.

Then give instructions using all 8 compass directions like: take 2 steps NorthEast, take 3 steps Southwest etc. … Repeat these directions until the learners are confident about all 8 directions.

NOTE: This is exactly what happens in the learning activities COMMAND THE ROBOT 1 and 2 but Logo does not use compass directions. However, behind all this is the THEME OF UP, DOWN, LEFT and RIGHT which provides an introduction to the important concept of VECTORS.

Return to your work area and ask about the angles between the directions (45°).

You could use Pirate 1's route as an introduction to the task. If you have a group, then the learners could work in pairs to describe a route for Pirate 2 in which he picks up everything in the picture and returns to his starting point.

If you can give each pair a copy of the map they can mark their routes for Pirate 2 on the map and then these can be used, with the descriptions alongside, in a wall display of the learners' work.

Do the Diagnostic Quiz at the end of the session.

Key questions

- Which way are you facing?
- Now turn to face East? Which way did you turn?
- How would you get from … to … ?
- How many steps (squares) is it from … to …?

SOLUTION

Pirate 1's route:
3 squares North to treasure chest 1;
then diagonally 1 South East to the fish bones;
2 squares North East to coins 1;
2 squares South to the skull & crossbones 1;,
1 square South West to the shark;
4 squares East to the crown;
then 4 squares south to meet Pirate 2.

Pirate 2's route (there are many answers here):

4 squares North picking up the crown;
2 squares North and 1 West picking up Wreck 1;
4 squares South picking up the diamond;
2 squares South and 1 West picking up the coins 2;
3 squares North picking up the ship 1;
4 squares North and 1 West picking up the coins 1;
2 squares South picking up the skull & crossbones 1;
1 squares Southwest picking up the shark;
2 squares South picking up the wreck 2;
2 squares South picking up the mermaid;
1 square Northwest picking up treasure chest 2;
4 squares North picking up the fish bones;
1 square Northwest picking up treasure chest 1;
1 square Northwest picking up the cutlass;
5 squares South picking up skull & crossbones 2;
2 squares South picking up the ship 2;
7 squares East to his starting point.

NOTE: It is important to distinguish between the directions Northwest (North 45° West) and 2 squares North and 1 West (North 26.6° West to the nearest 0.1 degrees).

These are **different directions.**

For younger learners you can just point out that the angle is 45° in one case and not in the other.

Secondary – BEARINGS

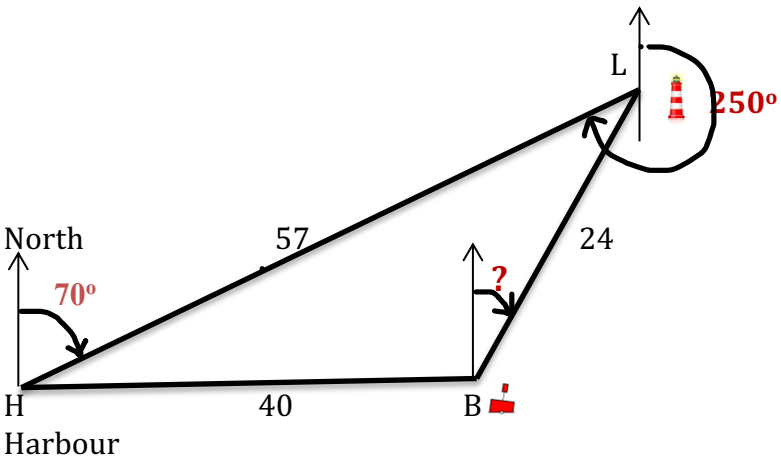
A bearing is the angle, measured in the clockwise direction, between the north south direction and a line connecting two points. Bearings are always given by 3 figures.

For example, in the diagram below, the bearing of L from H is 070°

and the bearing of H from L is 250°.

A small boat leaves a harbour H and travels due East (bearing 090°) for 40 km to a marker buoy B and then sails directly towards a lighthouse L which is 24 km from B. It then returns to the harbour H, a distance of 57 km on a bearing of 250°. Either by a scale drawing, or using trigonometry, find the bearing of the lighthouse L from the buoy B (the angle marked with a ? mark in the diagram).

Example



SOLUTION

The angle ∠LHB can be found from the information given using a scale drawing. This angle is 126° to the nearest degree. The bearing of the lighthouse from the buoy is 126° – 90° = 36° (to the nearest degree).

All the angles can be calculated using the cosine rule.

Alternatively, as we are given ∠**LHB**, we can use the sine rule.

$$\frac{\sin \angle \mathrm{HBL}}{57} = \frac{\sin \angle \mathrm{LHB}}{24} = \frac{\sin 20^o}{24}$$

sin ∠HBL= 57sin20°/24 = 0.8123 (to 4 dec. pl.)

∠HBL = 126° (as we know it is an obtuse angle).

The bearing of the lighthouse from the buoy is 126° – 90° = 36° (to the nearest degree.

Upper Secondary –

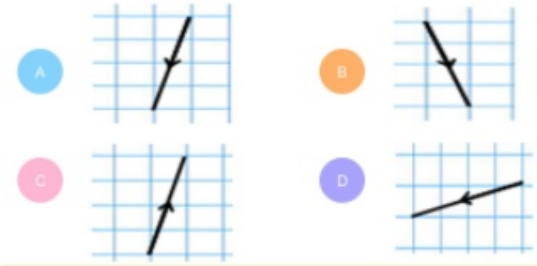
UP DOWN LEFT OR RIGHT (an introduction to vectors)

If you are not familiar with compass directions then do the learning activity on page 1, otherwise just have a look at it. Next do the following activity which introduces the important concept of vectors. Start by doing the Diagnostic Quiz on page 4.

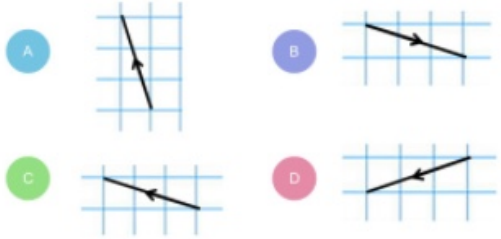
Vectors are simple. A vector is a measure having direction as well as length. Vectors in the plane are described by their components given by distances across and up.

To learn about vectors, answer the following multiple-choice questions.

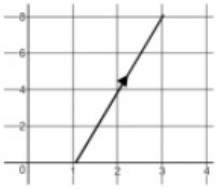
1 Which vector is the same as the column vector $\begin{pmatrix}-1\\-4\end{pmatrix}$?



2 Which vector is the same as column vector $\begin{pmatrix}3\\-1\end{pmatrix}$?



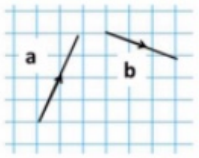
3

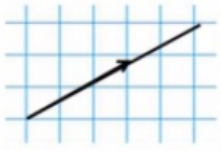


Which column vector matches the vector in the diagram?

A $\begin{pmatrix}2\\4\end{pmatrix}$ B $\begin{pmatrix}-2\\8\end{pmatrix}$ C $\begin{pmatrix}2\\8\end{pmatrix}$ D $\begin{pmatrix}4\\8\end{pmatrix}$

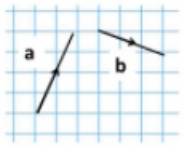
4 This diagram shows vector **a** and vector **b**. Which vector is shown in this diagram?

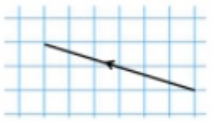




A **a + b** B **a + 2b** C None of these D **a − b**

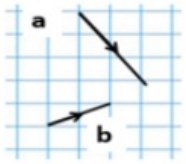
5 This diagram shows vector **a** and vector **b**. Which vector is shown in this diagram?

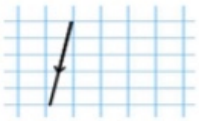




A **a + b** B **−2b** C **2b** D **a − b**

6 This diagram shows vector **a** and vector **b**. Which vector is shown in this diagram?





A $a + b$ B $a - 2b$ C None of these D $a - b$

Solutions

1. The correct choice is A. The other vectors are: B.$\begin{pmatrix}1\\-4\end{pmatrix}$, **C.**$\begin{pmatrix}1\\4\end{pmatrix}$, **D.**$\begin{pmatrix}-4\\-1\end{pmatrix}$
2. The correct choice is B. The other vectors are: A.$\begin{pmatrix}-1\\3\end{pmatrix}$, **C.**$\begin{pmatrix}-3\\1\end{pmatrix}$, **D.**$\begin{pmatrix}-3\\-1\end{pmatrix}$
3. The correct choice is A.
4. The correct choice is A. The other vectors are: B.$\begin{pmatrix}8\\2\end{pmatrix}$, **D.**$\begin{pmatrix}-1\\5\end{pmatrix}$
5. The correct choice is B. The other vectors are: A.$\begin{pmatrix}5\\3\end{pmatrix}$, **C.**$\begin{pmatrix}6\\-2\end{pmatrix}$, **D.**$\begin{pmatrix}-1\\5\end{pmatrix}$
6. The correct choice is B. The other vectors are: A.$\begin{pmatrix}4\\-2\end{pmatrix}$, **D.**$\begin{pmatrix}5\\1\end{pmatrix}$.

Why do this activity?

Learners enjoy this activity while at the same time learning mathematics. They think of it as a game and get practice in using compass directions. There are also many possible correct solutions so learners can experience a sense of ownership of their solution.

Learning objectives

In doing this activity students will have an opportunity to learn about compass directions and practise using them

Generic competences

In doing this activity students will have an opportunity to:

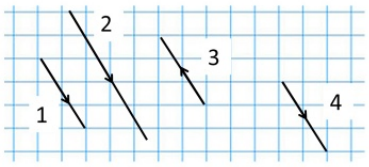
- develop the **skill of visualizating and** interpreting visual images to represent situations;
- **interpret and communicate** information in writing and present information and ideas to others.

DIAGNOSTIC ASSESSMENT This can be used before or after the lesson.

Show this question and say:

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

A vector is a measure having direction as well as length. Vectors in the plane are described by their components which are given by distances across and up.



Which vectors in this diagram are the same?

A 1 and 4

B All

C 1, 3 and 4

D None

1. Notice how the learners respond. Ask them to explain why they gave their answer and DO NOT say whether it is right or wrong, simply thank the learner for the answer.
2. It is important for learners to explain the reason for their answer so that, by putting their thinking into words, they develop communication skills and gain a better understanding.
3. With a group, make sure that other learners listen to these reasons and try to decide if their own answer was right or wrong.
4. Ask the learners to vote for the right answer by putting up 1, 2, 3 or 4 fingers. Look for a change and

The correct answer is: A

Possible misconceptions

B. These are all parallel vectors but they are not the same.

C. Vector 3 is in the opposite direction to 1 and 4 so it is not the same.

D. Going between different points, and therefore representing different journeys, does NOT make vectors unequal. Vectors are equal when they are the same length and go in parallel directions. https://diagnosticquestions.com

Follow up

Command the Robot 1

https:/aiminghigh.aimssec.ac.za/years-4-9-command-the-robot-1/

Command the Robot 2

https://aiminghigh.aimssec.ac.za/years-4-9-command-the-robot-2/

People Coordinates https://aiminghigh.aimssec.ac.za/years-6-to-9-people-coordinates/