Escape Rooms for Green Entrepreneurship

PEDAGOGICAL SEQUENCE

The circular journey of Martha



KEY TOPICS

review of mathematical concepts

Target group: learners aged 16+
Duration: 4 sessions (approx. 45 - 60 minutes each)

Introduction

The game requires participants to solve some mathematical puzzles. This pedagogical sequence introduces learners to key concepts that need to be revised before proceeding to the game.

Learning outcomes

Learners will be able to:

- Identify and classify numbers (natural, prime, composite, integers)
- Apply basic operations (addition, multiplication, division, averages) to solve problems
- Use inequalities, ordering and constraints to eliminate incorrect solutions

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Key concepts, definitions and examples

Natural Numbers

Definition:
Natural numbers are positive whole numbers used for counting.
Example:
1,2,3,4,5,6,7,8,9,10,11 are all natural numbers.

Set of numbers

Definition:
A set is a collection of numbers considered together.
Example:
The numbers {1,2,2,3,4,4,5,6,7,10,11} form the set used in the puzzle.

Prime Number

Definition:
A prime number is a whole number greater than 1 that has exactly two divisors: 1 and itself.
Example:
7 is prime because it can only be divided by 1 and 7.

Composite Number

Definition:
A composite number is a whole number greater than 1 that has more than two divisors.
Example:
6 is composite because it can be divided by 1,2,3 and 6.

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Divisor

Definition:
A divisor is a number that divides another number without leaving a reminder.
Example:
2 is a divisor of 10 because 10 / 2 = 5.

Addition

Definition:
Addition is the operation of combining numbers to find a total.
Example:
4 + 6 + 10 = 20

Sum

Definition:
The sum is the result of adding numbers together.
Example:
The sum of 3,5, and 7 is 15.

Multiplication

Definition:
Multiplication is an operation that represents repeated addition.
Example:
If a black circle has the number 5 and is connected to 3 gray circles:
5 x 3 = 15

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Product

Definition:
The product is the result of multiplication.
Example:
The product of 4 x 3 is 12.

Average (Arithmetic Mean)

Definition:
The average is found by adding all values and dividing by the number of values.
Example:
If gray circles contain 2, 4, and 6:
(2+4+6) / 3 = 4.

Division

Definition:
Division spits a number into equal parts.
Example:
12 / 3 = 4

Integer

Definition:
An integer is a whole number with no decimal or fractional part.
Example:
−2, 0, 5, and 11 are integers.
3.5 is not an integer.

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Inequality

Definition:
An inequality compares two values to show they are not equal.
Example:
8 < 12 means 8 is less than 12.

Greater Than / Less Than

Definition:
Greater than (>) means larger
Less than (<) means smaller
Example:
20 > 15
5 < 9

Graph (Mathematics)

Definition:
A graph is a structure made of points connected by lines to show relationships.
Example:
The puzzle diagram shows circles (points) connected by lines, forming a graph.

Node (Vertex)

Definition:
A node is a point in a graph where lines meet.
Example:
Each circle in the puzzle (red, gray, or black) is a node.

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Edge

Definition:
An edge is a line connecting two nodes in a graph.
Example:
A line connecting a black circle to a gray circle is an edge.

Degree of a Node

Definition:
The degree of a node is the number of edges connected to it.
Example:
If a black circle is connected to 4 gray circles, its degree is 4.

Constraint

Definition:
A constraint is a rule that limits possible solutions.
Example:
“Only prime numbers can be placed in red circles” is a constraint.

Constraint Satisfaction Problem

Definition:
A constraint satisfaction problem is a problem where all rules must be satisfied at the same time.
Example:
Placing numbers so that:
All numbers are used,
sums match required values,
and
inequalities are true,
is a constraint satisfaction problem.

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Logical Deduction

Definition:
Logical deduction is using rules and known facts to reach correct conclusions.
Example:
If red circles must be prime, the number 4 cannot be placed there.

Unique Solution

Definition:
A unique solution is the only arrangement that satisfies all constraints.
Example:
Only one way of placing the numbers fulfills all sum, average, and inequality rules.

Ordering

Definition:
Ordering means arranging numbers from smallest to largest or vice versa.
Example:
If the final values are 6, 14, and 21, the correct order is:
$6 < 14 < 21$

Permutation (Without Repetition)

Definition:
A permutation without repetition is an arrangement where each item is used exactly once.
Example:
Using the numbers 2, 3, and 5 so that none are repeated is a permutation without repetition.

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Activities

Number classification exercise

Learners are given a set of numbers and must classify them as natural, prime, composite or integers, justifying their choices using divisors and definitions.

Short exercise: Give learners the numbers **1, 2, 6, 7, 9 and 11**. Ask them to identify which are prime and which are composite, and to write the divisors of each number. Learners should notice that **1 is neither prime nor composite**, while all the given numbers are natural numbers and integers.

Calculation tasks

Learners calculate sums, products or averages linked to nodes and edges, reinforcing the concepts of degree, graph structure and arithmetic operations.

Short exercise: Draw one black node connected to three grey nodes containing the numbers **2, 4 and 6**. Ask learners to:

- calculate the degree of the black node;
- calculate the sum and average of the grey-node values;
- calculate the product of the black-node value 5 and its degree.

Answers: degree = 3; sum = 12; average = 4; product = 15.

Constraint satisfaction challenge

Learners place numbers into colored circles while respecting multiple constraints (prime numbers only, inequalities, fixed sums), practicing logical deduction and elimination strategies.

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Mini-challenge: Learners must place the numbers **2, 3, 4 and 5** into four circles labelled A, B, C and D. Each number may be used only once. The following constraints apply:

- A must contain a prime number;
- B must contain a composite number;
- A < B;
- C + D = 8;
- C < D.

Learners solve the puzzle and explain which constraint helped them eliminate each incorrect possibility.
Solution: A = 2, B = 4, C = 3 and D = 5.

Ordering and permutation task

Learners arrange numerical results in ascending or descending order and verify that each number is used once, reinforcing ordering and permutation without repetition.

Short exercise: Give learners the results **12, 5, 18 and 9**. First, they arrange them in ascending order using inequality symbols. They then create three different arrangements using each value exactly once and check that no number has been omitted or repeated.
Ascending order: 5 < 9 < 12 < 18.

Evaluation

Learners complete a short problem combining classification, calculation and constraints, demonstrating their ability to apply mathematical reasoning coherently. Correct reasoning and respect of all constraints indicate readiness for the escape room puzzles.

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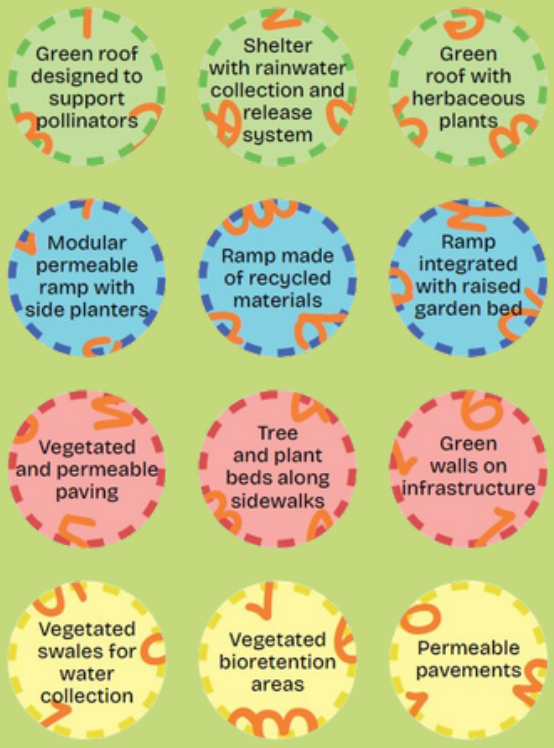

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