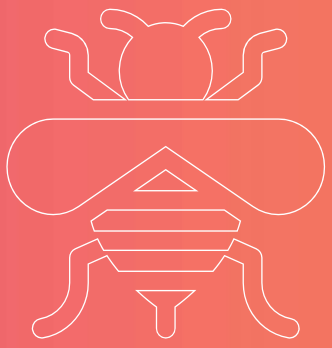
# LESSON SCENARIO 14:
# SYSTEM OF LINEAR EQUATIONS



**Topic: Linear Equations**

**Level: Age 13 -15**

**Foreknowledge: Elementary mathematic operations, solving linear equations with one unknown**

**Correlation: Non-formal games, brain teasers**

**Time: 45 min**

## LEARNING OUTCOMES

- Students will practice, through a gamified method, on how to find the solution for a linear system of equations, utilizing the method of substitution

## TEACHING METHODS

- Group work
- Cooperation

## KEY WORDS

- System of Linear Equations
- Set of Variables
- Solution of a System

## RESOURCES

- Paper
- Pencil
- VR headsets

## INTRODUCTION: RULES OF CONDUCT WHEN USING VR IN THE CLASSROOM (5 min)

The teacher starts discussion with the students asking them about the use of VR and their expectations in using VR in classroom.

After the discussion the teacher defines the work methods and rules of conduct for students regarding safety precautions for using VR headsets in the classroom and learning in virtual environment:

- listen to the teacher carefully
- remove physical obstacles before using VR
- always work in pair - never alone
- keep the device clean.

## INTRODUCTION TO LINEAR EQUATIONS (20 MIN)

The teacher begins by explaining to the students the definition of a system of linear equations saying that is being composed of two or more linear equations which employ the same set of variables.

The teacher will afterwards make an introduction or remind the students the method of substitution, as a method of solving a linear system with two equations and two variables.

All the theory that must be reminded is given below:

In mathematics, a system of linear equations is being composed of two or more linear equations which employ the same set of variables. Solution of a linear system is one assignment of values which satisfy all the equations of the system at the same time. For instance, for the following linear system of two equations in two variables x, y:

$x + 2y = 7$

$x - y = 1$

The solution is given by the assignment $x = 3$ and $y = 2$, inasmuch such assignment of values makes both equations valid at the same time.

The same applies for a linear system of three equations in three variables x, y, z, such as the following:

x + 2y + z = 9

x - y - 2z = -3

x + y + z = 6

in which x = 2, y = 3 and z=1 or (x, y, z) = (2, 3, 1) is the solution of this linear system.

Within the current tool, we will focus on the method of substitution, as a method of resolving a linear system of equations. We will try to explain the method through the following example, a linear system which involves 2 equations in 2 variables:

2x + 3y = 8

4x - 5y = -6

As a first step, we solve one of the two equations for x in terms of y, or for y in terms of x. In this case we choose to solve the first equation for x in terms of y:

2x + 3y = 8

2x = 8 – 3y

$x = \frac{8-3y}{2}$

$x = 4 - \frac{3y}{2}$

At this stage, we substitute this expression of x into the other (second) equation of the linear system. Hence the equation 4x - 5y = -6 will take the form of: $4(4 - \frac{3y}{2}) - 5y = -6$

16 – 6y – 5y = -6

16 – 11y = -6

-11y = -22

$\frac{-11y}{-11} = \frac{-22}{-11}$

y = 2

**Now, we substitute y = 2 back into any equation of the system that involves the variable x. For instance, we substitute y = 2 into the equation 2x + 3y = 8:**

**2x + 3· 2 = 8**

**2x + 6 = 8**

**2x = 2**

**x = 1. So, the solution is x = 1 and y = 2 or (x, y) = (1, 2)**

**Introduction of the exercise and accomplishment of the task (15 MIN)**

**The teacher asks the students to form pairs in order to work together and solve the following using the method of substitution. One of the students, student (a), will be the one with the virtual reality headset and the other student, students (b), will be the one writing. Student (b) will guide and help student (a) by writing on paper the exercises.**

**At some point, it is being suggested that the students swap places – student (b) will be the one with the virtual reality headset and student (a) the one writing – so that they can both use the application.**

**When clicking on the virtual reality application math reality, the students will have to select 'system of linear equations' from the book exercises (select # - system of linear equations). Student (a) will have to answer the questions with student's (b) support and click on the button "check the answer".**

**TASK**

**Using the method of substitution presented above, try to find an arithmetic value for all the items.**

**Student (B) can ask student (A) how do they start? Student (A) would answer that**

**"The arithmetic value of the metal weight**  **equals to 20g, they need to start by finding the value of the candy."**

**The student with the VR headset, Student (A), starts solving the exercise. The students are given that 1 metal weight = 20g, and a scale which contains 1 (one) candy on the right-hand side.**

1. **How many weights are needed to balance the scale? The students need to click on the tiny weights to add them to the scale.**

**Student (A) has three choices (a) 20, (b) 30, (c) 40.**

**Solution: 2 weights = candy = 40g**

2. **How many candies are needed to balance the scale? The students need to click on the candies to add them on the scale.**

**Student (A) has three choices: (a) 100, (b) 200, (c) 300**

**Solution: 5 candies = apple = 200g**

**For question 3, Student (A) can swap places with Student (B).**

3. **How many apples are needed to balance the scale? The students need to click on the apples to add them on the scale.**

**Student (B) has three choices: (a) 300, (b) 500, (c) 600**

**Solution: 3 apples = surprise box = 600g**

20 g =

## EVALUATION

| | | | | | |
|---|---|---|---|---|---|
| 1. I like the way of work in this lesson. | 1 | 2 | 3 | 4 | 5 |
| 2. This lesson was interesting. | 1 | 2 | 3 | 4 | 5 |
| 3. It is clear what I was supposed to learn in this lesson. | 1 | 2 | 3 | 4 | 5 |
| 4. The subject matter was clearly explained. | 1 | 2 | 3 | 4 | 5 |
| 5. I have learned the subject matter. | 1 | 2 | 3 | 4 | 5 |
| 6. I think I actively participated in this lesson. | 1 | 2 | 3 | 4 | 5 |
| 7. I was more active in this lesson than usually. | 1 | 2 | 3 | 4 | 5 |
| 8. By being active I contributed to the quality of the lesson. | 1 | 2 | 3 | 4 | 5 |
| 9. I was motivated for work in this lesson. | 1 | 2 | 3 | 4 | 5 |
| 10. I prefer using VR in lessons. | 1 | 2 | 3 | 4 | 5 |
| 11. Name two things you liked in this lesson. | | | | | |
| 12. Name two things you didn`t like in this lesson. | | | | | |

# INCLUSIVENESS GUIDELINES

**Every student is different and their needs for the material might vary. Below you will find several tips that could make mathematics lesson more inclusive for students who struggle with learning disorders.**

- **When giving assignments to classroom try to break them into small pieces of information. Avoid the double tasks in the instructions. Remember that in case of operations/exercises with multiple steps, it is critical to help learners decompose the steps.**
- **You can use checklists for your students to make sure they have done all the steps**
- **Make sure the font, line spacing, and alignment of your document is accessible for students with learning disorders. It is recommended to use a plain, evenly spaced sans serif font such as Arial and Comic Sans. Others: Verdana, Tahoma, Century Gothic and Trebuchet. Spacing should be 1.5 and try to avoid justification in the text.**
- **At the end of each activity, take some time to ask the students what they have learnt to acknowledge every step in their learning process**
- **Make sure that the material the students manipulate is easy enough to grasp**
- **While using different media (paper, computer and visual aids) choose different background than white which can be to bright for students with learning disorders. The best choice would be cream or soft pastel but try to test different colors to learn more about student's preference.**
- **To stimulate short and long-term memory prepare for all the students in the classroom an outline describing what they are going to learn on this lesson and finish it with a resume of what has been taught. In this way they will strengthen the ability to remember information.**

**EXAMPLE:**

**1. Start every lesson with a short "CHECK-IN"**

- **Today, we will study the topic (name of the topic)**
- **I will tell you about: (name 3 keywords connected with the topic)**
- **Then I will present exercises: (name the exercises form the student book)**
- **Then we will do exercises (explain the way student will be working: ex. together with teacher / in pairs /individually)**
- **Once the exercises will be done [To continue]**

**2. Then finish lesson with a short "CHECK-OUT"**

- **During the lesson we learn about (topic of the lesson)**

- **The most important things were: (name 3 keywords connected with the topic)**
- **We were able to do… (tell about the work student done during the lesson)**
- **We will explore the topic next time when we will learn about (name the following topic)**

**It is a small adjustment that will take 5 min from the lesson but can make a great difference in the way that the material will be remembered. Try to create this as a routine habit.**