FunForLab

Serious games to learn (about) the profession
of medical laboratory technologist (MLT)

User Guide of the Game

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Introduction

The FunForLab project

Through the development and sharing of two Serious Games, the Interreg FunForLab project will address several target audiences:

- Secondary school pupils: Promote scientific professions, including MLT among secondary school students.

- MLT students: Increasing specific skills on automated analyses, reach equivalent training in EMR, increase cross border mobility, thus increasing employability.

- MLT professionals: Opportunity to use FUNFORLAB as a ICTE tools for continuing education

- Jobseekers via scientific training courses
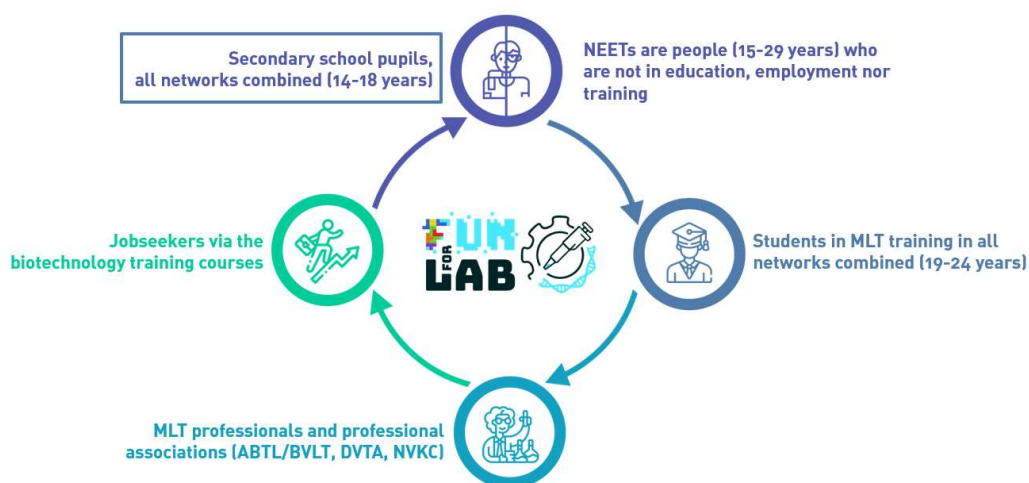
Figure 1. FunForLab target audiences

FunForLab Secondary school objectives

Secondary school pupils and teachers are one of the two major target groups for the FunForLab project. The SWOT analyse conducted at the beginning of the project highlighted that the general public is unaware of what an MLT is. This partially explains the current labour market situation. As a matter of fact, MLT is currently a shortage occupation in all 3 countries surveyed. Through our workshop campaign, we aim to raise awareness around MLTs. This will help create vocations amongst pupils.

The FunForLab context

An MLT is a paramedical health professional who carries out in vitro laboratory tests on human samples (such as blood or urine,) and who supervises the analysis and guarantees the accuracy of medical data. The MLT helps establishing an accurate diagnosis for doctors.
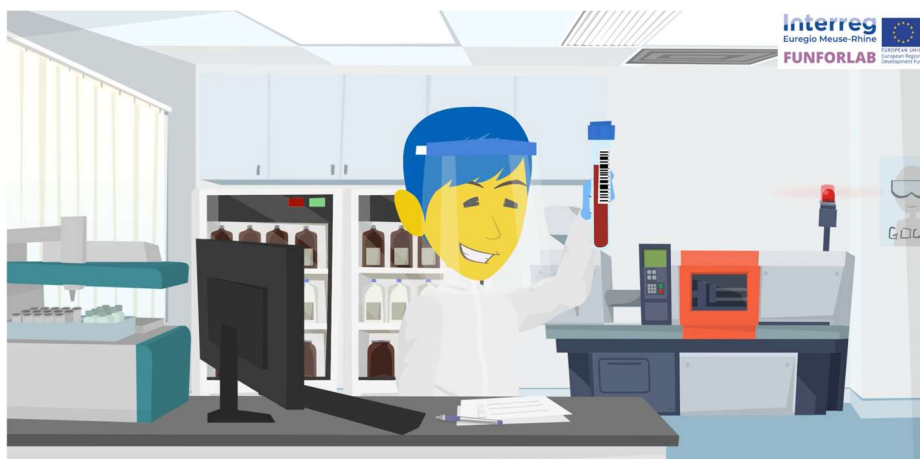
Figure 2. Medical laboratory technologist

The Euregio Meuse-Rhine members are the following five regions: The Province of Liège, German-speaking Community and province of Limburg in Belgium, the Southern part of the province of Limburg in the Netherlands and the Province of Aachen in Germany.
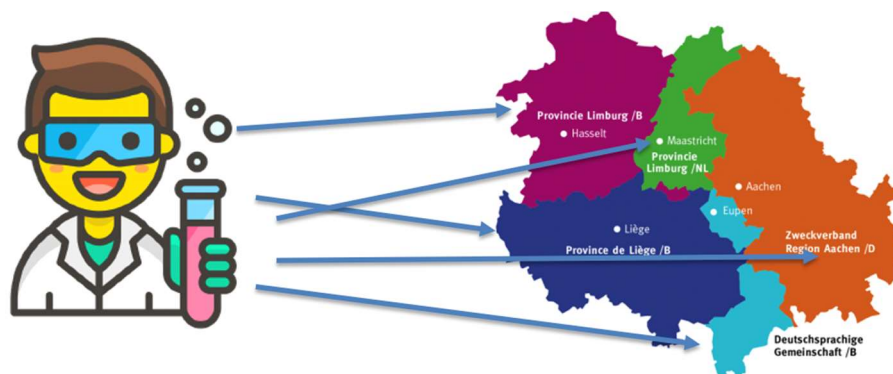
Figure 3 MLT Cross border Mobility in EMR

The partners

Six partners for on joined efforts and shared knowledges:

Figure 4 FunForLab partners in EMR

To meet these challenges, the Funforlab project brought together a consortium including:

- The CRIG Research Center (HELMo, Liège, BE), as leadpartner;

- With support of MLT graduate school UCLL (Hasselt, BE), ZUYD (Herleen, NL), UKAachen (Aachen, DE) as financial partners bringing in pedagogical and technical skills in the field of sciences and biomedical sciences;

- CECOTEPE Training Center (HEPL, Liège, BE), and FoRS Research Center (Henallux, Namur, BE), as financial partners experienced in developing of IT tools and Virtual Reality.

The supports

The FunForLab project is supported by:

The FUNFORLAB project is funded by the European subsidies INTERREG EMR for CALL 6 in the field of social inclusion.

The project is also co-financed by the Walloon Region and the Wallonia Brussels Federations and German Region, in Belgium; the Province of Limburg in The Netherlands and the Ministry for Economic Affairs, Innovation, Digitalisation and Energy of the State of North Rhine-Westphalia in Germany.

The User Guide

This User guide is intended to help secondary schools' science teachers of Euregio Meuse-Rhine to become game facilitators.

It contains:

- Project objectives
- The game's pedagogical tools
- Instructions for using the game
- Methodology for classroom use

The aim is to have a common pedagogical framework for all regions in EMR when raising awareness amongst students.

The guide is addressed to teachers and is to be used in conjunction with the Training manual created for pupils.

The pedagogical tool

Game story

Year 2051. Despite numerous warnings from scientific experts and alarming reports from the IPCC over the past decades, not enough had been done to combat climate change. Natural disasters, wars and virus epidemics have increased. Melting ice is causing the waters to rise, making many parts of the world inhospitable. With the help of the largest multinationals, the governments of many countries have organised the colonisation of planet Mars to save humanity. This mission is called EMR (Earth to Mars Rescue). Priority is given to people with useful capabilities that needs to be certified by laboratories. Rumour has it that some labs are run by mafias and falsifying results. A young MLT is hired by the European secret services to verify the validity of results coming out from one suspected lab and help dismantle a local mafia. If they succeed, they will be rewarded with a MLT job on a spaceship going to Mars. They will be allowed to bring along their asthmatic little sister who's suffering from Earth's climate change.

The story takes place in the future, it is a dystopia where climate change has made the earth inhospitable. The subject is topical and interesting to discuss with pupils:

a) Environmental awareness: understanding humans' impact on the environment and the resulting imbalances in ecosystems.
b) Learning about sustainability: educating encouraging eco-friendly behaviour.
c) Developing a sense of responsibility: learning that the way we live has an impact on the environment, therefore reinforcing commitment.
d) Understanding collective action: explaining how collective actions have enhanced impact, emphasising the importance of solidarity in setting up collective projects.

Teaching pupils about the causes and consequences of climate change makes them more likely to take a pro-active and positive approach to the environmental challenges they will face in their daily lives.

Serious Game

Serious Game definition*: A serious game is an "educational application, whose initial intention is to combine, coherently and at the same time, serious aspects, in a non-exhaustive and non-exclusive way, teaching, learning, communication, or even information with the fun aspects of video games" [ALV 07].*

From: Connected Healthcare for the Citizen, 2018

Serious Game advantages in a school context:

a) Motivation and engagement: serious games can capture the students' attention and motivate them, consequently improving their engagement and participation rates.
b) Experiential learning: serious games provide simulations of real-life situations that allow students to discover for themselves the consequences of their actions and decisions.
c) Immediate feedback: serious games provide immediate feedback, allowing students to correct mistakes and quickly understand good practice without being judged.
d) Collaboration: serious games provide opportunities for collaboration and competition between students, which stimulates communication and teamwork.
e) Customisation: students make progress at their own pace.

The FunForLab video game is a Point and Click game i.e., an adventure video game where the player interacts with their surrounding by clicking on items using the mouse or keyboard. The player must solve puzzles by collecting objects and use logic to progress through the story.

Scientific themes

The scientific method

The scientific method is a systematic approach used to investigate and understand the natural world. It involves a series of steps that scientists use to formulate and test hypotheses, evaluate evidence, and draw conclusions.

Observation	Government hired us to redo some laboratory tests from another laboratory. They think the results from this other laboratory were not up to standards.
Formulating a question	Are those results trustworthy or not? Is the sample healthy or pathological?
Developing a hypothesis	If we retest samples in our laboratory and find different results, we could think their results are not to be trusted: falsification of medical data occurred.
Designing an experiment	Testing of 2 samples from this laboratory in which we suspect data falsification
Collecting and analysing data	Comparing results between our lab and the one from the suspicious laboratory. They are not the same.
Drawing conclusions	The suspicious lab published falsified results
Communicating findings	Communicating of correct results to the Government

The scientific subjects

a) Oxygen transport at organ and organism level (case 1)
b) Microscope cells observation (case 2)
c) Infection (case 1)
d) Composition of blood: counted Blood Cells (CBC) and quiz questions (case 1 and 3)
e) Observing safety rules in a laboratory (all cases)
f) Blood tests (hemogram)
g) Concentrations/units (all cases)

Instructions for using the game

The sequences:

There are 7 sequences to the game.

1.   Prologue:

The context story of the game is explained in a cinematic. No interaction is required in this sequence.

2.   Tutorial:

The tutorial is about how to play the game. The player will be given instructions on how to interact in game and will be given tryout. The robot gives a lab tour explaining the purpose of all the rooms.

3.   Introduction

The player will explore the venous puncture, sampling and blood testing. The player will be tested on their knowledge through 5 questionnaires. The questions and answers from the tests are available in Appendix 1.

4.   First case (Bernie Russo)

The player will perform their first CBC analysis with the automaton. Given the results, they will report a suspicion of anaemia to the Government (answer in Appendix 2). The player will be tested on their knowledge through one questionnaire. The question and answer are available in Appendix 1.

5.   Second case (Aureliano Foguinho)

As the automaton is temporarily broken, the player will perform a blood analysis with a microscope. They will have to compare the blood sample with other bloods references to determine if it is healthy or not (answer in Appendix 2).

6.   Third case (Julia Balmont)

The player will perform a CBC analysis with the automaton and a mutlistix urine analysis. Given the results they will report to the Government that the results from the first lab were falsified as the blood results show that the blood is a male blood, and the urine shows abnormal glucose value (answer in Appendix 2).

7.   Epilogue

The end of the story is described in a cinematic. It explains the reward received for dismantling the mafia and bridge with the virtual reality game. No interaction is required in this sequence.
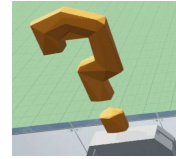
Informative elements:

A green arrow shows you the direction to the avatar.

A yellow arrow shows you the direction to the Robot.

An exclamation mark appears when interaction is requested

A question mark appears when an action is requested

How to play depending on equipment:

1.   With a mouse

To move the player, left click on the ground where you want to move him.

Left click on the **Continue** button from the text box (or space bar or Enter) to go to the next sentence. You won't be able to move on if the text is still showing.
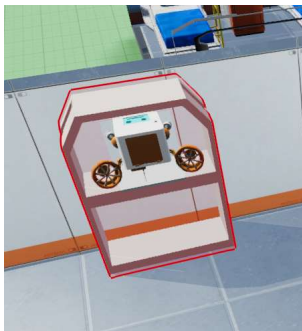
To move the camera, hold down the left mouse button and drag.

To rotate the view, hold down the right mouse button and drag.

To zoom in or out, use the mouse wheel.

To go back to initial position after a close mode (zoom out), right click.

To interact with objects that have a red outline, left click on them.

Drag and drop the tools available in your basket inventory (top right of the screen) using the left click.

Hovering some items triggers a description box.

2.   With a touchpad

To move the player, left click on the ground where you want to move him.

Left click on the ![Continue] button from the text box (or space bar or Enter) to go to the next sentence. You won't be able to move on if the text is still showing.

To move the camera, hold down the left button and drag your finger.

To rotate the view, hold down the right button and drag your finger.

To zoom the view in or out, moves 2 fingers closer or further apart on the touchpad.

To interact with objects that have a red outline, left click on them.
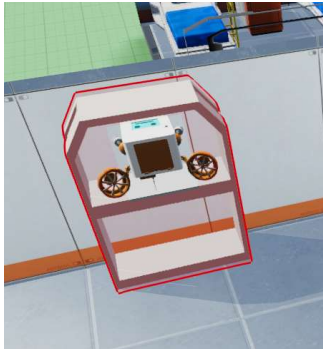
Drag and drop the tools available in your basket inventory (top right of the screen)

Hovering some items triggers a description box.

Game FAQS

a) What do I need to play?

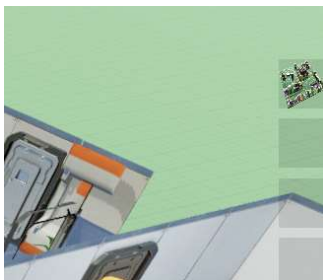Windows® 10 64-bit PC, mouse, keyboard ;
250 MB free hard disk space
High-resolution graphics card

b) Installing the game

Download the data from our website. You will receive a zip file. Unzip this folder and open it. As soon as you click on FunForLab.exe, the game will start. Once you see the menu, you can go to the scenario selection to choose your level.

c) How long does it take to play FunForLab?

The speed also depends on the pupil's computer skills.

On average,

Prologue	3 minutes
Tutorial	10 minutes
introduction	10 minutes
First case	10 minutes
Second case	10 minutes
Third case	10 minutes
Épilogue	2 minutes

The whole game takes around 55 minutes.

d) How do I move the avatar?

Click the left mouse button on the ground where you want to move it.

e) The avatar doesn't follow my instructions

If there is a text displayed, have you already clicked on "continue"?

f) I can't answer the questions

To answer a question, select the correct answer and scroll down. Submit your answer by clicking on "validate".
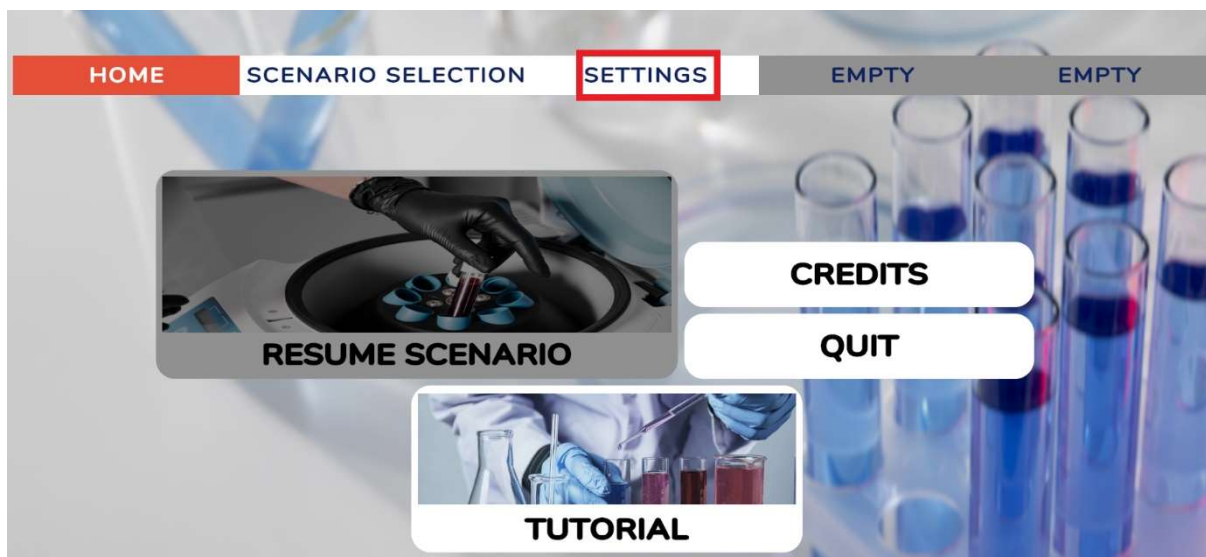
g) How do I leave full-screen mode?

Alt + Enter

h) How to close close-ups

Use the right button of your mouse to click, the screen will change again.

i) How do I change the language?

The game can be played in 4 languages (English, Dutch, German and French). The language can be changed in Settings

j) How to change the player's name

 Start the tutorial to do so

(k) How do I put on PPE Personal Protective Equipment (PPE)?

Go to the changing room, click on the cupboard (highlighted in red when the mouse hovers over it)

l) I'm stuck, the game won't load!

Press "esc" to return to the menu and resume the game.

m) Resuming the game

If you left the game using the escape button and were in the middle of a scenario, this button will take you back to the middle of the scenario. If you quit the game (by closing the window), the "resume scenario" button will take you back to the start of the scenario you were in.

n) Can I play without sound?

Yes, the sound does not provide any additional information.

The pedagogical sequence

The teaching sequence is a separate document available on our website. It proposes an activity to be set up in class, during the biology lesson. It consists of a scientific activity and a media education activity.

Scientific activity

Target skills

This teaching sequence will enable pupils to take an active part in the scientific process, building up knowledge through the following 3 stages:

- Appropriation of the problem
- Gathering information
- Processing and communicating information.

At the end of this activity, the following processes will be practiced:

- Compare physiological data from a healthy person and a person suffering from an infectious disease (blood test, urine test, microscopic observations, etc.).
- Interpret graphs and tables obtained from analytical assays.
- Interpret results by analysing and arguing.
- Design and present a scientific poster.

Courses and Duration

4 ½ periods in the scientific training course (biology course)

Prerequisites
- Composition of blood :
    - o Plasma and serum
    - o Blood cells: WBC, RBC and platelets
- Light microscope

Media education activity

Target skills
- Media education

Through 3 areas:

- The ideology of the game
- The game's pedagogical approach
- The reliability of information in the game

Courses and Duration

30 min in the scientific training course (biology course) or in a media education course.
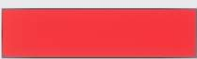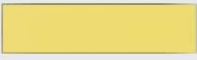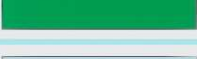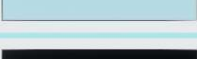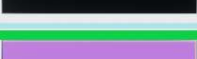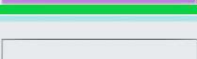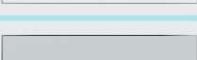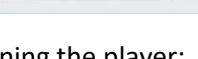
Prerequisites
- Playing the FunForLab Point & Click game

Appendix

Appendix 1 – Questionnaires answers

Questionnaire 1: The colour cap choice

Specimen Type	Additive	ISO 6710 (2017)	Color
Serum	Clot activator	Red	
Serum with gel	Gel, clot activator	Yellow	
Plasma	Heparin	Light Green	
Plasma with gel	Gel, heparin	Dark green	
Plasma	Citrate (1:9)	Light Blue	
Whole blood	Citrate (1:4)	Black	
Whole blood	EDTA	Lavender	
Plasma EDTA with gel	Gel, EDTA	White or Pearl	
Plasma	Glycolytic inhibitor	Grey	

Information given in the introduction before questioning the player:

"This is a tube containing EDTA (Ethylen-Diamin-Tetra-Acetate) fluid."

And after the tube choice:

"This fluid stabilises the blood cells and prevents the blood from clotting, which is necessary for our CBC analysis."

Questionnaire 2: Venous puncture equipment

Answers:

- Gloves
- Disinfectant
- Single-use needle
- Tourniquet
- Swab
- Sample tubes
- Needle trash bin
- Labels

- Bandage

Not needed for a venous puncture:

- NaCl (salt)
- Chronometer

Information given in the introduction before questioning the player:

"I'll tell you how I operate now. After clearing your arm, I tie the tourniquet. I disinfect the area of the sting. I insert the needle and fill the sample. I release the tourniquet. I take the needle out. And there you have it. Now I gently swirl the tube to avoid coagulation."

A video of a real venous puncture is also displayed before the questionnaire.

Questionnaire 3: Some sample tubes contain additives to prevent clotting. What is the additive for a CBC analysis?

Answer	Description
EDTA	Ethylenediaminetetraacetic acid Anti- clotting agent : for haematology, immuno-haematology, genetics, glycated haemoglobin and immunosuppressive tests
Other proposals	
Citrate	Anti-clotting agent : for thrombosis-haemostasis analyses, fill to the mark indicated on the tube
Heparin	Anti-clotting agent: For clinical chemistry
NaCl	Salt
Ethanol	Ethyl alcohol

Information in the game, see Test 1.

Questionnaire 4: What cells do we find in human blood?

Answers	Description
Platelets	Platelets are also known as thrombocytes. They are produced in the bone marrow and help the blood to clot.
Red blood cells	Cells that transport oxygen. Their number depends on e.g. sex and age
White blood cells	Cells involved in immune defence which play a key role in the body's defence against e.g. viruses and bacteria which can cause infections
Other proposals	
Astrocytes	Astrocytes are glial cells of the central nervous system. They are generally star-shaped,
Blue blood cells	Invention for the play

Questionnaire 5: Just before performing the CBC analysis, the EDTA tube should be gently mixed several times, true or false?

Answer	Description
True	To avoid sedimentation of the cells at the bottom of the tube
Other proposal	
False	Shaking to hard could damage the cells

Information given in the introduction when the robot explains the venous puncture:

"And there you have it. Now I gently swirl the tube to avoid coagulation."

Questionnaire 6: What is the role of haemoglobin in human red blood cells?

Answer
Oxygen supply
Other proposals
Immunosuppression
Starting coagulation
Prevent blood vessels from calcifying
Hydrogen bonding

Information given to the player at the beginning of case 1 (at the scan of the sample) regarding haemoglobin:

"We will need to perform a haematological analysis and check its haemoglobin level. This is a measurement of the red blood cells in your blood, which carry oxygen from your lungs to your organs. If you have a low haemoglobin level you often feel tired and exhausted. For example, cyclists who use EPO increase their haemoglobin levels to improve their performance."

Appendix 2 – Analyse answers

Introduction: CBC analyse from the player blood[1]

PARAM	VALUE	MALE RANGES	FEMALE RANGES
WBC	4,8 /nL	4 /nL - 10 /nL	4 /nL - 10 /nL
RBC	4,5 /pL	4,4 /pL - 6,0 /pL	4,2 /pL - 5,5 /pL
HB	145,3 g/L	140 g/L - 180 g/L	120 g/L - 160 g/L
HCT	42,5%	40 % - 54 %	37 % - 47 %
MCV	89,3 fL	82 fL - 97 fL	82 fL - 97 fL
MCH	32,1 pg	27 pg - 36 pg	27 pg - 36 pg
MCHC	345,4 g/L	320 g/L - 360 g/L	320 g/L - 360 g/L
PLT	212,0 /nL	140 /nL - 400 /nL	140 /nL - 400 /nL
ESR	13,0 mm/h	< 22 mm/h	< 24 mm/h

No results out of range, no disease to report.

First case: CBC analyse from Bernie Russo's blood[1]

PARAM	VALUE	MALE RANGES	FEMALE RANGES
WBC	4,9 /nL	4 /nL - 10 /nL	4 /nL - 10 /nL
RBC	3,4 /pL	4,4 /pL - 6,0 /pL	4,2 /pL - 5,5 /pL
HB	87,0 g/L	140 g/L - 180 g/L	120 g/L - 160 g/L
HCT	26,4%	40 % - 54 %	37 % - 47 %
MCV	87,4 fL	82 fL - 97 fL	82 fL - 97 fL
MCH	28,5 pg	27 pg - 36 pg	27 pg - 36 pg
MCHC	330,0 g/L	320 g/L - 360 g/L	320 g/L - 360 g/L
PLT	383,0 /nL	140 /nL - 400 /nL	140 /nL - 400 /nL
ESR	30,0 mm/h	< 22 mm/h	< 24 mm/h

Anemia is the disease to select in the codex.

Anemia description in the codex: "According to the definition of the World Health Organisation (WHO) anemia is defined as a lack of hemoglobin. In this case, you can see a decrease in hemoglobin concentration (HB), then in RBC count and hematocrit (HCT)."

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[1] All CBC analyse tables presented have been created for the game. In laboratories, the reference values are automatically adapted to the patient's sex.

Second case: Microscope analyse from Aureliano Foguinho's blood
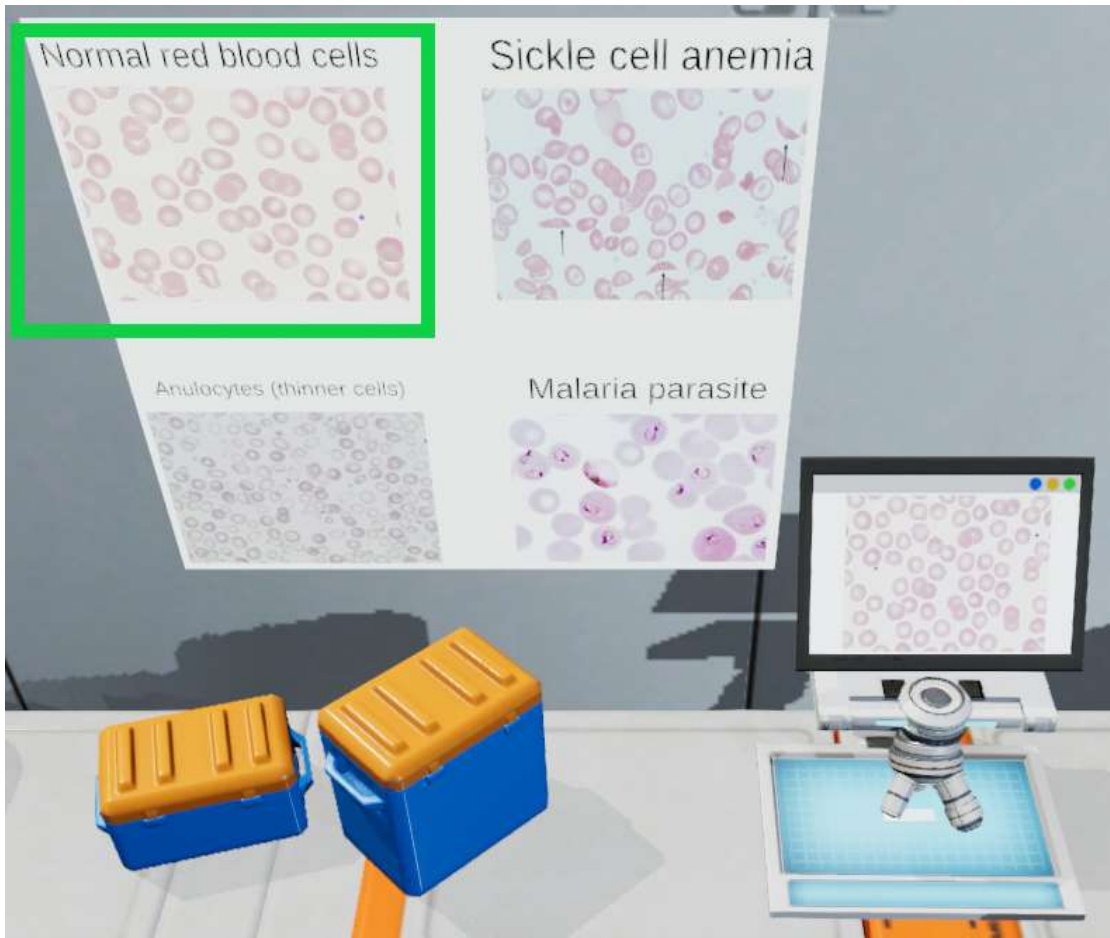
The red blood cells from the sample are normal red blood cells

- Anemia: According to the definition of the World Health Organisation (WHO) anemia is defined as a lack of hemoglobin. In this case, you can see a decrease in hemoglobin concentration (HB), then in RBC count and hematocrit (HCT).

- Anulocytes : Anulocytes are ring cells and monoconcave hypochromic erythrocytes (red blood cells). The reddish cytoplasm can mainly only be seen as a rim. They are smaller than normal erythrocytes and do not appear in the blood of healthy people.

- Malaria is an infectious disease caused by a parasite of the genus Plasmodium, spread by the bite of certain species of mosquito. The smear enables plasmodii to be identified on the basis of their specific characteristics and the deformations undergone by the parasitized red blood cells.

Third case: CBC and multistix analyse from Julia Balmont's blood

Multistix analyse:
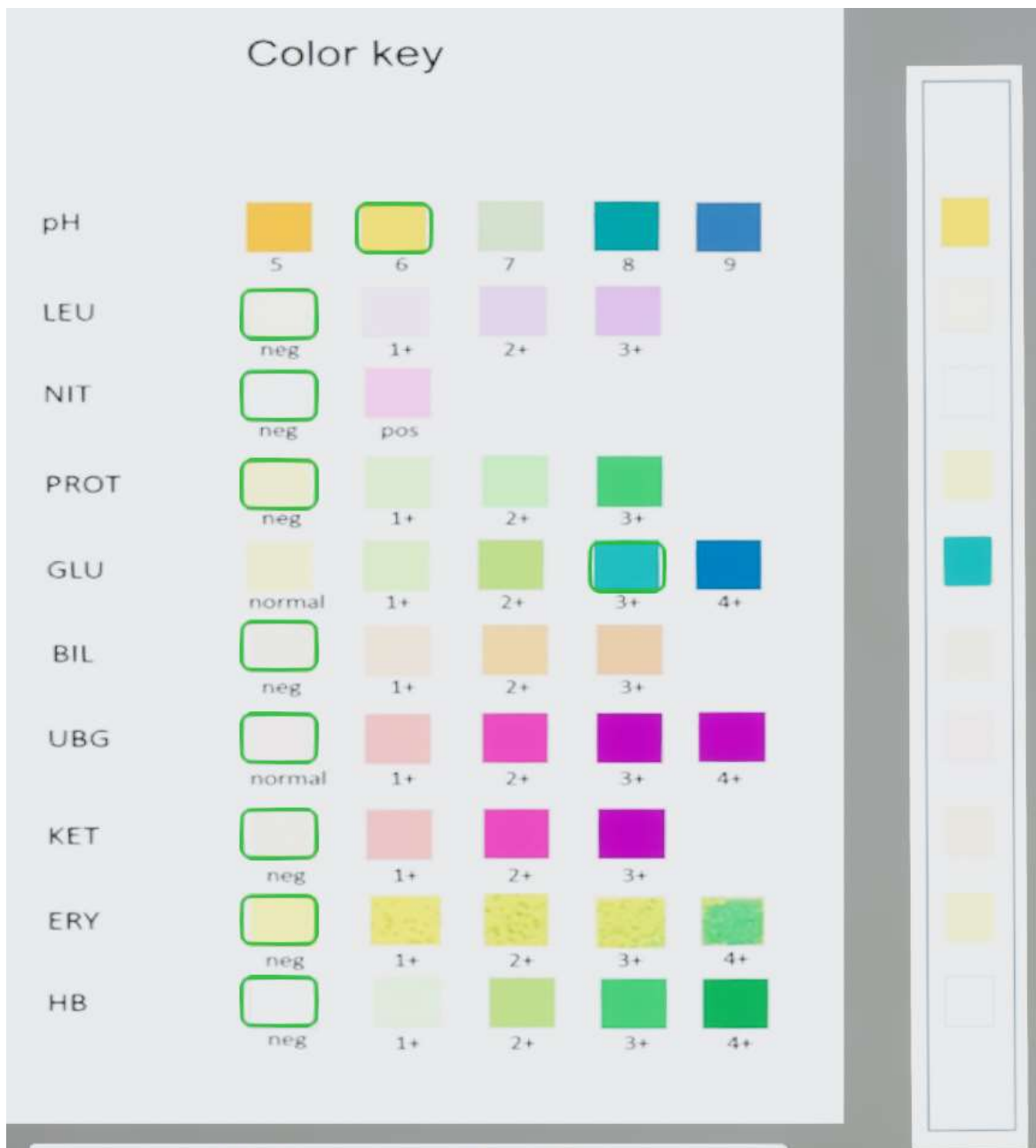
Diabetes is the disease to select in the codex.

Diabetes description in the codex: "Diabetes is characterised by chronic hyperglycaemia, i.e. too much glucose in the blood (blood sugar). This disease occurs when the pancreas does not produce enough insulin or the body does not use the insulin it produces properly. Glucose levels are first measured in the blood, but a urine test can be performed to detect the presence of glucose (GLU), urine normally should not contain any trace of glucose. The presence of glucose (GLU) in the urine can be a sign of several pathologies including diabetes."

CBC analyse[1]:

PARAM	VALUE	MALE RANGES	FEMALE RANGES
WBC	9,5 /nL	4 /nL - 10 /nL	4 /nL - 10 /nL
RBC	5,2 /pL	4,4 /pL - 6,0 /pL	4,2 /pL - 5,5 /pL
HB	172,0 g/L	140 g/L - 180 g/L	120 g/L - 160 g/L
HCT	50,0%	40 % - 54 %	37 % - 47 %
MCV	96,4 fL	82 fL - 97 fL	82 fL - 97 fL
MCH	33,0 pg	27 pg - 36 pg	27 pg - 36 pg
MCHC	344,0 g/L	320 g/L - 360 g/L	320 g/L - 360 g/L
PLT	379,0 /nL	140 /nL - 400 /nL	140 /nL - 400 /nL
ESR	12,0 mm/h	< 22 mm/h	< 24 mm/h

Values are abnormal for a female sample.

Information given to the player after selecting Diabetes in the codex:

"We can suspect three potential causes for these high values.

- One, she is taking EPO, this can be considered as a form of doping, potentially dangerous for her health.
⇨ Reminder of the EPO effect, increase of the haemoglobin (HB) levels. See questionnaires 6 for more details)
- Two, Julia Balmont's sample is in fact that of a man, which would directly reveal a falsification of the results.
⇨ If the sample blood was a male sample, it would be between normal ranges. They might have switched blood sample with a healthy male blood sample not knowing that the ranges for some parameters would change.
- Three, Julia Balmont is suffering from a severe disease.

In all three cases, the access to the shuttle would be refused for Julia. I therefore suggest a temporary ban and a more thorough investigation because the suspicion of fraud remains very present."

Appendix 3 – Scientific information

CBC analyse normal ranges

CBC parameter	Normal range adults	Adults male	Adults female
WBC	4 /nL - 10 /nL		
RBC		4,4 /pL - 6,0 /pL	4,2 /pL - 5,5 /pL
HB		140 g/L - 180 g/L	120 g/L - 160 g/L
HCT		40 % - 54 %	37 % - 47 %
MCV	82 fL - 97 fL		
MCH	27 pg - 36 pg		
MCHC	320 g/L - 360 g/L		
PLT	140 /nL - 400 /nL		
ESR		< 22 mm/h	< 24 mm/h

Remark: normal values depend on the method of measuring, the reagents used and the automatons!)
→ So there can be some variability of normal values for different automatons and regions even if they use the same principle of measuring.

CBC analyse Units

Haematological analysis parameters	Abbreviations meanings	Definition (short)	Units (short)	Units (long)
WBC	White Blood Cell = Total of white blood cell	Cells involved in immune defence which play a key role in the body's defense against e.g. viruses and bacteria which can cause infections	Number of cells/nl	per Nanoliter (10^{-9})
RBC	Red blood cell= Globules rouges (GR)	Cells that transport oxygen. Their number depends on e.g. sex and age	Number of cells/pl	per Picoliter (10^{-12})
HB	Hemoglobin	A major component of the RBC is made up of pigment (heme which binds iron) responsible for the red colour of the blood and a protein part (globin). It transports oxygen (O2) from the lungs to the body's tissues. Hb also performs the opposite function by transporting carbon dioxide (C02) from tissues to the lungs.	g/l	Gramm/liter
HCT	Hematocrit	The volume held by the red blood cells in the blood in relation to the total volume of blood.	%	Percent
MCV	Mean Corpuscular Volume	The average volume of red blood cells	fl	Femtoliter (10^{-15})
MCH	Mean Cell Hemoglobin	This is the average level of haemoglobin per red blood cell	pg	Picogramm (10^{-12})
MCHC	Mean Corpuscular Haemoglobin Concentration	This is the average level of haemoglobin in the volume occupied by red blood cells in the blood.	g/l	Gramm/liter
PLT	Platelets	Platelets are also called thrombocytes. They are made in the bone marrow and help the blood to clot	Number of cells/nl	per Nanoliter (10^{-9})
ESR	Erythrocyte Sedimentation Rate	The sedimentation rate (SR) is also called the Biernacki reaction. It is the rate at which red blood cells suspended in the blood sediment, i.e. settle to the bottom of a test tube	mm/h	Milimeter per hour