# FunForLab

Serious games for learning (about) the profession of medical laboratory technologist (MLT)

Educational sheet

Interreg Euregio Meuse-Rhine
FUNFORLAB
EUROPEAN UNION
European Regional Development Fund

# Contents

1. Science lesson activity (Biology) ..... 3
Target skills ..... 3
Setting the scene (parallel to the Serious game) ..... 3
Course and duration ..... 3
Prerequisites ..... 3
Activity sequence ..... 4
Phase 1 (1/2 period) ..... 4
Phase 2 (1/2 period) ..... 4
Phase 3 (1 period) ..... 4
Phase 4 (2 periods) ..... 4
Phase 5 (1/2 period) (*) ..... 5
 Teaching resources in English ..... 6
Teaching resources in French/ Ressources pédagogiques ..... 6
Teaching resources in German / Ressourcen für den Unterricht ..... 8
Teaching resources in Dutch / Leermiddelen ..... 8
 Teaching aid 1: Case ..... 9
Case 1 ..... 9
Case 2 ..... 11
Case 3 ..... 13
 Educational tool 2: Scientific poster ..... 22
 Teaching aid 3: Corrective measures ..... 23
Case 1 ..... 23
Case 2 ..... 27
Case 3 ..... 31
 Teaching aid 4: Summary ..... 36
2. Media education activity ..... 38
Target skills ..... 38
Methodology ..... 38
Course and duration ..... 39

Prerequisites ..... 39
Activity sequence ..... 39
 Teaching aid 5: Media literacy questionnaire ..... 40

# 1. Science lesson activity (Biology)

## 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:

- Problem ownership
- Information gathering
- Information processing and communication

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

- 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.

## Setting the scene (parallel to the Serious game)

Global warming is increasingly threatening life on Earth. The governments of a number of countries have organised the colonisation of the planet Mars to save humanity. This is the EMR (Earth to Mars Rescue) mission. For this mission, the government has to select very specific profiles (analysed in laboratories). As places are limited and the selection criteria very demanding, fraudulent methods have been developed to falsify the results.

The pupils are invited to take on the role of Medical Laboratory Technologists (MLTs), hired by the government to check the validity of the results of a laboratory suspected of fraud. They will have to present the conclusions of their analyses to the government.

## Course and duration

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

## Prerequisites

- Blood composition :
  - Plasma and serum
  - Blood cells: WBC, RBC and platelets
- Optical microscope

# Activity sequence

## Phase 1 (1/2 period)

Before discovering the analyses, each pupil will **write a** brief **description** of a medical analysis laboratory (type of analyses carried out, machines used, results obtained, etc.) and of the job of Medical Laboratory Technologist (MLT). This stage will enable the pupils to draw on their initial perceptions. Pupils should keep their descriptions for future reference.

## Phase 2 (1/2 period)

**Formation of Medical Laboratory Technologist (MLT) groups**: 3 groups of a maximum of 5 pupils (if there are more pupils in the class, multiply the groups).

**Distribution of the 3 cases to be analysed** between the different groups (1 case/group).

**Distribution of documents**. Each group receives their case and questions to help them analyse it (  **1**). These answers will help them to create their poster.

## Phase 3 (1 period)

(  ) **Find out about the analysis methods used and the results.** The pupils find out about the method(s) assigned to them(*) . This information will enable them to understand, present and explain their analysis method(s) to the class.

*(*) This stage can be carried out using ICT, to familiarise pupils with computer tools and put them in the shoes of a scientist.*

**Taking ownership of the case and gathering information**. The pupils use the documents to look for clues and identify leads. They use these resources to put forward hypotheses and plausible explanations.

## Phase 4 (2 periods)

**Processing and communicating information.** Each group produces a scientific poster (  2). It will include the following elements(*) :

- a description of their analysis method(s) (those requested in their documents),
- analysis results,
- hypotheses and explanations,
- the conclusion

Each group appoints a rapporteur. This person will be responsible for presenting the poster. Each MLT reporter will have a predefined time set by the teacher for their presentation.

The other MLTs in the group will have to answer any questions that the "government" might ask. They will therefore have to be able to answer any questions about the items on their poster.

The "government" is made up of pupils who are not part of the group presenting the poster. They listen carefully to the presentation so that they can ask questions.

Appropriation of roles. Pupils can bring accessories (clothing or other) related to the MLT profession.

Room layout and spatial arrangements for the presentation (lectern, poster stand, etc.).

Presentation of the poster to the "government". This stage allows them to communicate the results of their analyses to the whole class and take part in a scientific discussion.

*(*) The form can be drawn up either on a large sheet of paper with markers, or using a computer.*

## Phase 5 (1/2 period) (*)

**Structuring.** Synthesis of the knowledge acquired (  **3 and 4**):

- Corrections to the case analyses. And distribution of the content to the class so that all the pupils keep a record of all the analysis methods used and the associated pathologies.
- Revisiting the concept of a medical analysis laboratory
- The role of a MLT

*(*) This phase can be carried out in addition to or instead of phase 4.*

## Teaching resources in English

Silberstein, L. E. (2013). Hematology: Basic Principles and Practice. Royaume-Uni: Saunders/Elsevier.

https://www.bloodline.net/imageatlas/

https://bhs.be/education/bhs-courses/bhs-educational-courses-2021-2023

## Teaching resources in French/ Ressources pédagogiques

- FunForLab's serious game: the data for the cases to be analysed are inspired by the game.
- HAFERLACH Torsten, BACHER Ulrike, THEML Harald, DIEM Heinz, 2013, *Atlas de poche Hématologie (3° Éd.) Coll. Atlas de poche. LAVOISIER.*
- Medical analysis laboratory

*https://www.youtube.com/watch?v=KTIyfGYKNZw&ab_channel=CliniquesuniversitairesSaint-Luc (13/08/23)*

- Laboratory Technologist

*https://metiers.siep.be/metier/technicien-technicienne-technologue-laboratoire-medical/ (21/06/23)*

*https://www.leforem.be/infos-metiers/metiers/technologue-de-laboratoire-medical.html (21/06/23)*

*https://www.health.belgium.be/fr/sante/professions-de-sante/professions-paramedicales/technologue-de-laboratoire-medical#:~:text=The%20technologist%20of%20laboratory%20m%C3%A9dical%20must%20%C3%Are%20titular%20of%20a,royal%20of%2017%20January%202019%20. (21/06/23)*

https://www.youtube.com/watch?v=KTIyfGYKNZw (21/06/23)

***Case 1:***

- MSDmanuals. Blood smear [online]. Available from :

https://www.msdmanuals.com/fr/accueil/multimedia/lab-tests/frottis-sanguin (21/06/23)

- Medicover Hospitals. Blood smear [online]. Available from :

https://www.medicoverhospitals.in/fr/diagnostics-pathology-tests/peripheral-blood-smear-test (21/06/23)

- Virtual Vet. Blood smear [video on line]. Available on :

https://vimeo.com/253272213 (13/08/23)

- MSDmanuals. Assessment of anaemia [online]. Available from :

https://www.msdmanuals.com/fr/professional/h%C3%A9matologie-et-oncologie/prise-en-charge-du-patient-an%C3%A9mique/bilan-de-an%C3%A9mie (21/06/23)

- MSDmanuals. Anemia [online]. Available from :

https://www.msdmanuals.com/fr/accueil/troubles-du-sang/anémie/présentation-de-l-anémie (21/06/23)

- Europe 1 (Dr Kruzeck). Anemia [online video]. Available on :

https://www.youtube.com/watch?v=Vkv7POdwoTw&t=49s&ab_channel=Europe1 (13/08/23)

- Olympus. What is a digital microscope [online]. Available from :

https://www.olympus-ims.com/fr/insight/what-is-a-digital-microscope/ (21/06/23)

***Case 2:***

- MEDUCOL. Haemogram [video on line]. Available on :

https://www.youtube.com/watch?v=ZHr0xcDFO7E&ab_channel=Meducol-LaPlateformeM%C3%A9dicale (13/08/23)

- MSDmanuals. Assessment of anaemia [online]. Available from :

https://www.msdmanuals.com/fr/professional/h%C3%A9matologie-et-oncologie/prise-en-charge-du-patient-an%C3%A9mique/bilan-de-an%C3%A9mie (21/06/23)

- MSDmanuals. Anemia [online]. Available from :

https://www.msdmanuals.com/fr/accueil/troubles-du-sang/anémie/présentation-de-l-anémie (21/06/23)

- DZAIR. Sedimentation rate [video online]. Available on :

https://www.youtube.com/watch?v=6_cPNUnCuyA&ab_channel=ISPDZAIR (13/08/23)

***Case 3:***

- MEDUCOL. Haemogram [video on line]. Available on :

https://www.youtube.com/watch?v=ZHr0xcDFO7E&ab_channel=Meducol-LaPlateformeM%C3%A9dicale (13/08/23)

- DZAIR. Sedimentation rate [video online]. Available on :

https://www.youtube.com/watch?v=6_cPNUnCuyA&ab_channel=ISPDZAIR (13/08/23)

- University of Montpellier. Haemoglobin levels [video online]. Available on :

https://www.youtube.com/watch?v=p_KeJWRBBis&ab_channel=Universit%C3%A9deMontpellier (13/08/23)

- ALLODOCTEURS. Urinalysis [online video]. Available on :

https://www.youtube.com/watch?v=eW6RsA1z5nk&ab_channel=AlloDocteurs (13/08/23)

- MSDmanuals. Urine analysis and culture [online]. Available from :

https://www.msdmanuals.com/fr/accueil/troubles-r%C3%A9naux-et-des-voies-urinaires/diagnostic-des-troubles-du-rein-et-des-voies-urinaires/analyses-et-cultures-d-urine (21/06/23)

## Teaching resources in German / Ressourcen für den Unterricht

**Klinische Chemie**: Hallbach, J.: Klinische Chemieund Hämatologie (2019)
(ISBN 978-3-13-241798-4)
**Medizinische Mikrobiologie**: Hof.: Duale Reihe – Med. Mikrobiologie (2022)
(ISBN 978-3-13-244317-4)
**Histologie**: Lang, G.: Histotechnik: Praxislehrbuch für die Biomedizinische Analytik
(ISBN 978-3-211-33141-5)
**Hämatologie**: Mahlberg, R.: Hämatologie: Theorie und Praxis für med. Assistenzberufe
(ISBN 978-3-527-33468-1)
**Anatomie**: Kapit, W.: Malatlas Anatomie

**Krankheitslehre**: Pschyrembel Klinisches Wörterbuch

**Biologie**: Menche, N.: Biologie Anatomie Physiologie (2020)

## Teaching resources in Dutch / Leermiddelen

Klinische chemie en hematologie voor analisten, deel 1 en deel 2

- Auteur: Dr. E. ten Boekel, Dr. B.A. de Boer
  ISBN: 9789491764516
  Pagina's: 400
  Druk: 3e (2022)
- Auteur: Dr. E. ten Boekel, Dr. B.A. de Boer
  ISBN: 9789491764554
  Pagina's: 382
  Druk: 3e (2023)

Hematologie

- Auteur: Dr. J.J.M.L. Hoffmann, Prof. dr. J.W.N. Akkerman, Dr. H.K. Nieuwenhuis, Dr. M.A.M. Overbeeke
  ISBN: 9789077423257 Pagina's: 398 Druk: 2e (2006)

Microbiologie – Elementaire micorbiologie

- Auteur: Ir. G.A. Harrewijn ISBN: 9789077423271
  Pagina's: 312
  Druk: 5e

Laboratory guide (analyses and analytes)

https://www.zol.be/klinisch-laboratorium/labogids

# Teaching aid 1: Case

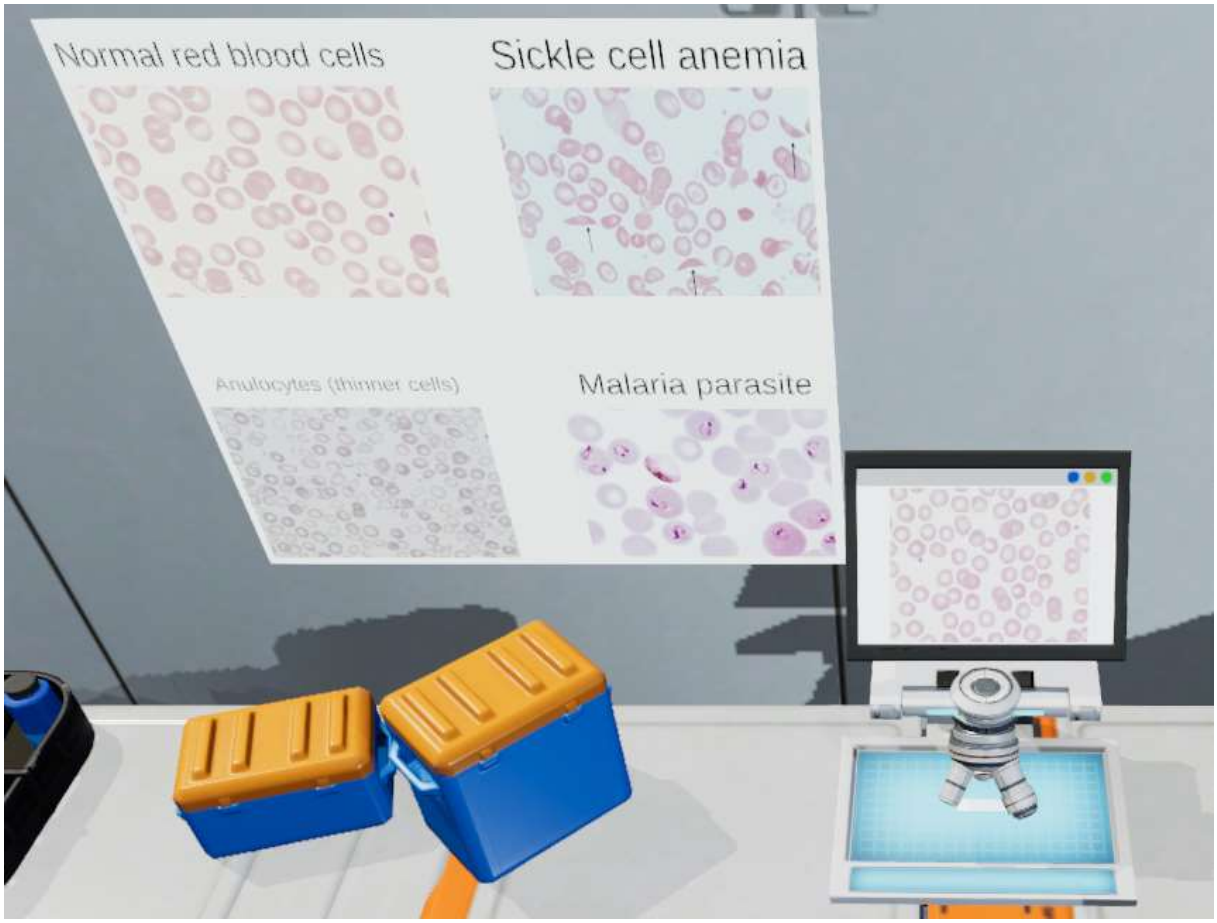
## Case 1

1) Description of a blood smear and digital microscope analysis

.....
.....
.....
.....
.....
.....
.....

2) Analysis results

Result for red blood cells of the digital microscope analysis of the blood smear from your sample



3) Observations and interpretation :

.....
.....
.....
.....
.....
.....
.....

4) What is anaemia?

.....
.....
.....
.....
.....
.....
.....

5) What would the red blood cells in a blood smear look like in anaemia? Please explain.

.....
.....
.....
.....
.....
.....
.....

6) Is there a suspicion of fraud (falsification of the identity (sex) of the person) for this sample? Explain

.....
.....
.....
.....
.....
.....
.....

## Case 2

1) Description of a haemogram (definition, objectives, analyses carried out, measurements, assays, etc.)

.....
.....
.....
.....
.....
.....
.....

2) What is the sedimentation rate?

.....
.....
.....
.....
.....
.....
.....

3) Analysis results

- Haemogram of a healthy person

| PARAM | VALUE | MALE RANGES | FEMALE RANGES |
|---|---|---|---|
| WBC | 4,8 /nL | 4 /nL - 10 /nL | 4 /nL - 10 /nL |
| RBC | 5,7 /pL | 4,4 /pL - 6,0 /pL | 4,2 /pL - 5,5 /pL |
| HB | 163,2 g/L | 140 g/L - 180 g/L | 120 g/L - 160 g/L |
| HCT | 48,2% | 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 |

- Blood count of your sample

Sample ID: 210432863
Demographic: Male 35 y/o
Requested Analysis:
- Hematology CBC

| 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 |

- Annexes A and B

4) Comments :

Does the healthy person's haemogram come from a man or a woman? Please explain.

.....
.....
.....
.....
.....
.....
.....

In the haemogram of your sample, why do some parameters appear in red? Please explain.

.....
.....
.....
.....
.....
.....
.....

5) Interpretation and conclusion :

.....
.....
.....
.....
.....
.....
.....

6) Is there a suspicion of fraud (falsification of the identity (sex) of the person) for this sample? Explain

.....
.....
.....
.....
.....
.....
.....

## Case 3

1) Analysis results

- Haemogram of a healthy person

| PARAM | VALUE | MALE RANGES | FEMALE RANGES |
|---|---|---|---|
| WBC | 4,8 /nL | 4 /nL - 10 /nL | 4 /nL - 10 /nL |
| RBC | 5,7 /pL | 4,4 /pL - 6,0 /pL | 4,2 /pL - 5,5 /pL |
| HB | 163,2 g/L | 140 g/L - 180 g/L | 120 g/L - 160 g/L |
| HCT | 48,2% | 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 |

- Blood count of your sample

Sample ID: 220689321
Demographic: Female 23 y/o
Requested Analysis:
- Hematology CBC

| 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 |

- Annexes A and B

2) Comments :

Does the healthy person's haemogram come from a man or a woman? Please explain.

.....
.....
.....
.....
.....
.....

In the haemogram of your sample, why do some parameters appear in red? Please explain.

.....
.....
.....
.....
.....
.....
.....

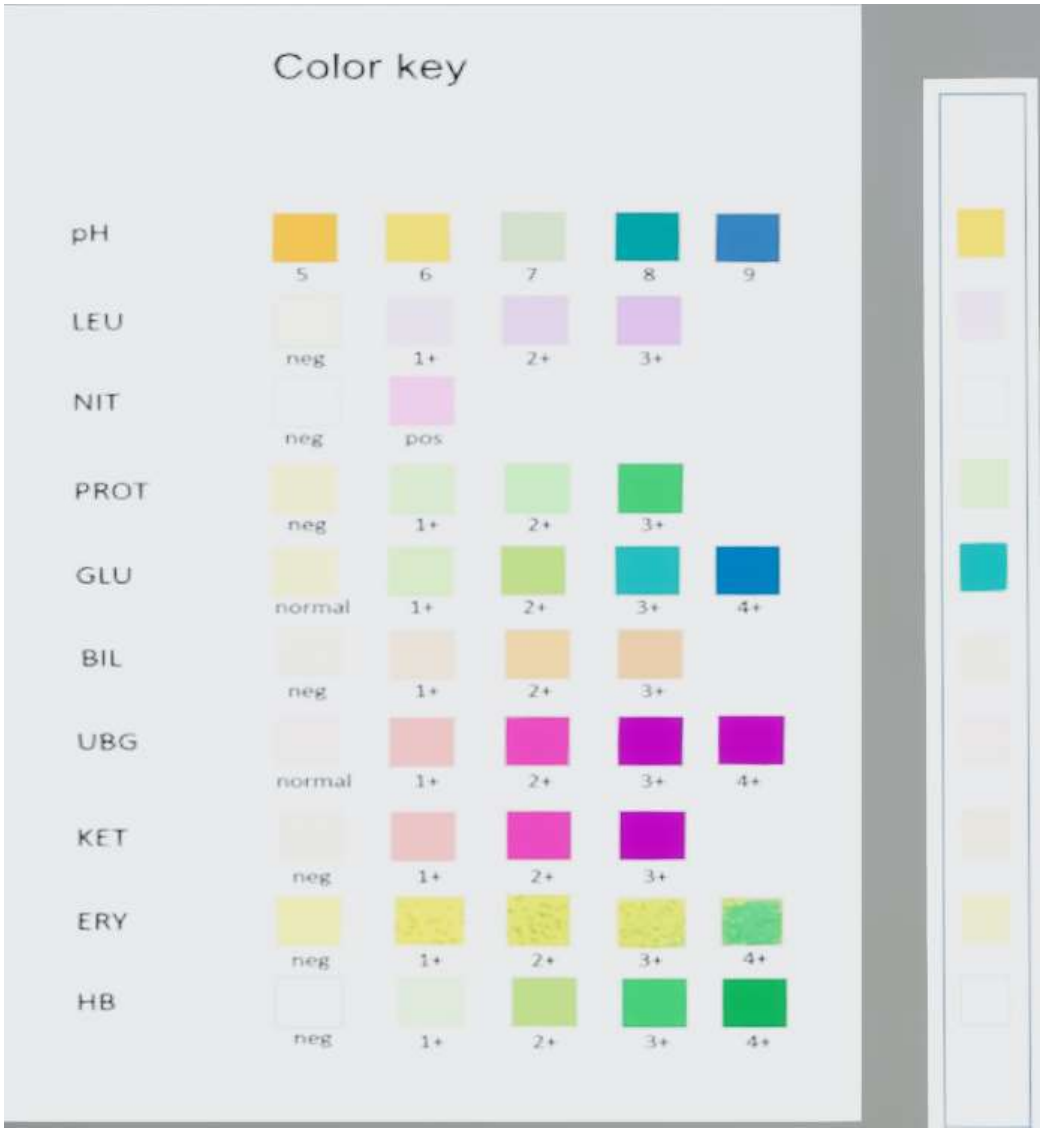
3) Interpretation based on analysis of the blood count of your sample :

.....
.....
.....
.....
.....
.....

4) Description of a urinalysis (by tigette)

.....
.....
.....
.....
.....
.....

5) Results of the urinary analysis (by tigette) of your sample



6) Observations and interpretation based on the urinary analysis of your sample :

.....
.....
.....
.....
.....
.....
.....

7) Conclusion:

.....
.....
.....
.....
.....
.....
.....

8) Is there a suspicion of fraud (falsification of the person's identity (sex)) for this blood sample? Explain

.....
.....
.....
.....
.....
.....
.....

**Appendix A**

Abbreviations for haematological analyses (In English)

| Abbreviations | Meanings | Brief definition | Unit (Symbol) | Unit |
|---|---|---|---|---|
| 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 nanolitre $(10\ L)^{-9}$ |
| 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 picolitre $(10\ L)^{-12}$ |
| 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 | gram/litre |
| HCT | Haematocrit | The volume held by the red blood cells in the blood in relation to the total volume of blood. | % | Percentage |
| MCV | Mean Corpuscular Volume | The average volume of red blood cells | fl | femtolitre $(10\ L)^{-15}$ |
| MCH | Mean Cell Hemoglobin | This is the average level of haemoglobin per red blood cell | Pg | picogram $(10^{-12}\ g)$ |
| 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 | gram/litre |
| 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 nanolitre $(10\ L)^{-9}$ |
| 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 | millimetre per hour |

Les abréviations pour les analyses hématologiques (en français)

| Abréviations | Significations | Brève définition | Unité (Symbole) | Unité |
|---|---|---|---|---|
| WBC | White Blood Cell = Globules Blancs (GB) Totaux | Cellules intervenant dans la défense immunitaire. Elles jouent un rôle clé dans la défense du corps contre les virus et les bactéries, qui peuvent causer des infections. | Nombre de cellules/nl | par nanolitre ($10^{-9}$L) |
| RBC | Red Blood Cell = Globules Rouges (GR) | Cellules responsables du transport de l'oxygène. Leur nombre dépend du sexe et de l'âge. | Nombre de cellules /pl | par picolitre ($10^{-12}$L) |
| HB | Hémoglobine | L'hémoglobine, constituant majeur du globule rouge (érythrocyte ou hématie), est constituée comme son nom l'indique d'un pigment (l'hème, fixant le fer) responsable de la couleur rouge du sang et d'une partie protéique (la globine). Elle transporte l'oxygène (O2) des poumons vers les tissus de l'organisme. L'hémoglobine remplit également la fonction inverse en transportant le dioxyde de crbone (CO2) des tissus vers les poumons. | g/l | gramme/litre |
| HCT | Hématocrite | Volume occupé par les globules rouges dans le sang par rapport au volume total de sang. | % | Pourcentage |
| MCV | Volume globulaire moyen (de GR) | Le volume moyen des globules rouges. | fl | femtolitre ($10^{-15}$L) |
| MCH | Teneur corpusculaire moyenne en hémoglobine | C'est le taux moyen d'hémoglobine par globules rouges. | Pg | picogramme ($10^{-12}$g) |
| MCHC | Concentration corpusculaire moyenne en hémoglobine | C'est le taux moyen d'hémoglobine dans le volume occupé par les globules rouges dans le sang. | g/l | gramme/litre |
| PLT | Plaquettes | Les plaquettes sont aussi appelées thrombocytes. Elles sont fabriquées dans la moelle osseuse et aident le sang à coaguler. | Nombre de cellules /nl | par nanolitre ($10^{-9}$L) |
| ESR (VS) | Vitesse de sédimentation | La vitesse de sédimentation (VS) est aussi appelée réaction de Biernacki. Elle correspond à la vitesse à laquelle les globules rouges en suspension dans le sang viennent se sédimenter, c'est-à-dire se déposer dans le fond d'un tube à essai. | mm/h | millimètre par heure |

Abkürzungen für hämatologische Analysen (auf Deutsch)

| Das Blutbild | Erklärung der Abkürzungen | Kurzdefinition | Einheiten (kurz) | Einheiten |
|---|---|---|---|---|
| **WBC** | weiße Blutkörperchen (Leukozyten) | Zellen mit Aufgaben im menschlichen Immunsystem: z.B. Abwehr von Krankheiten auslösenden (pathogenen) Bakterien und Viren. | /nl | pro Nanoliter ($10^{-9}$) |
| **RBC** | rote Blutkörperchen (Erythrozyten) | Erythrozyten transportieren Sauerstoff zu den Körperzellen. Ihre Anzahl hängt von Alter, Geschlecht und anderen Faktoren ab. | /pl | pro picoliter ($10^{-12}$) |
| **HB** | Hämoglobin | Das Hämoglobin ist verantwortlich für die rote Färbung der Erythrozyten. Die Hauptaufgabe des Hämoglobins ist die Bindung von Sauerstoff, den die Erythrozyten zu den Gewebszellen transportieren. Zudem ist Hämoglobin (HB) am Rücktransport von Co2 von den Organen zurück zur Lunge beteiligt. | g/l oder g/dl | Gramm/Liter oder Gramm/Deziliter |
| **HCT** | Hämatokrit | Volumen der Erythrozyten bezogen auf das gesamte Blutvolumen | % | Prozent |
| **MCV** | mittleres corpusculäres Volumen der Erythrozyten | durchschnittliches Volumen der Erythrozyten | fl | femtoliter ($10^{-15}$) |
| **MCH** | mittlerre corpusculärer Hämoglobingehalt | durchschnittlicher HB-Gehalt pro Erythrozyt | pg | Picogramm ($10^{-12}$) |
| **MCHC** | mittlere corpusculäre Hämoglobinkonzentration | durchschnittliche Hämoglobinkonzentration pro Liter oder Deziliter Erythrozyten | g/l oder g/dl | Gramm/Liter or Gramm/Deziliter |
| **PLT** | Blutplättchen (Thrombozyten) | Thrombozyten sind Blutplättchen. Sie sind maßgeblich am Gerinnungsprozess beteiligt. Thrombozyten werden - wie die anderen Blutzellen auch - im Knochenmark gebildet. | /nl | pro Nanoliter ($10^{-9}$) |
| **ESR oder BSG** | Erythrozytensedimentationsrate oder Blutsenkungsgeschwindigkeit | Bei der ESR (=BSG) wird in der senkrecht aufbewahrten Probe nach einem festgelegten Zeitpunkt, die durch Absinken der Erythrozyten (Sedimentation) entstandene Erythrozytensäule, abgelesen. | mm/h | Millimeter pro Stunde |

Afkortingen voor hematologische testen (in het Nederlands)

| Hematologische analyse | Betekenis van de afkortingen | Definitie (kort) | Eenheden (kort) | Eenheden |
|---|---|---|---|---|
| **WBC** | witte bloedcel = leukocyt | Cellen die betrokken zijn bij de immuunafweer en een sleutelrol spelen in het lichaam's verdediging tegen bijvoorbeeld virussen en bacteriën die infecties kunnen veroorzaken. | /nl | per nanoliter ($10^{-9}$) |
| **RBC** | rode bloedcel = erytrocyt | Cellen die zuurstof transporteren. Hun aantal is afhankelijk van onder andere geslacht en leeftijd. | /pl | per picoliter ($10^{-12}$) |
| **Hb** | Hemoglobine | Een belangrijk onderdeel van de rode bloedcellen (RBC) bestaat uit pigment (heem dat ijzer bindt), dat verantwoordelijk is voor de rode kleur van het bloed, en een eiwitdeel (globine). Het transporteert zuurstof (O2) van de longen naar de weefsels van het lichaam. Hb vervult ook de tegenovergestelde functie door koolstofdioxide (CO2) van weefsels naar de longen te transporteren. | g/l | gram/liter |
| **Ht** | Hematocriet | Het volume dat wordt ingenomen door de rode bloedcellen in het bloed in verhouding tot het totale bloedvolume. | % | Procent |
| **MCV** | Mean Corpuscular Volume | Het gemiddelde volume van de rode bloedcellen. | fl | femtoliter ($10^{-15}$) |
| **MCH** | Mean Corpuscular Hemoglobin | Dit is het gemiddelde niveau van hemoglobine per rode bloedcel. | pg | picogram |
| **MCHC** | Mean Corpuscular Hemoglobin Concentration | Dit is het gemiddelde niveau van hemoglobine in het volume dat door rode bloedcellen in het bloed wordt ingenomen. | g/l | gram/liter |
| **PLT** | bloedplaatjes = trombocyt | Bloedplaatjes worden ook wel trombocyten genoemd. Ze worden geproduceerd in het beenmerg en helpen bij het stollen van het bloed. | /nl | per nanoliter |
| **BSE** | bezinkingssnelheid van de erytrocyten | De bezinkingssnelheid (BSE) is de snelheid waarmee rode bloedcellen in een bloedmonster bezinken. | mm/h | milimeter per uur |

**Appendix B**

Normal values: see below

| **CB**C **parameter** | ***Normal*** adult ***values*** | ***Adult*** men | ***Adult*** women | ***unit***s |
|---|---|---|---|---|
| WBC | 4-10 | | | /nl |
| RBC | ----- | ***4,4 - 6,***0 | ***4,2 - 5,***5 | /pl |
| HB | ----- | ***140 -*** 180 | ***120 -*** 160 | g/l |
| HCT | ----- | ***40 -*** 54 | ***37 -*** 47 | % |
| MCV | ***82 -*** 97 | | | fl |
| MCH | ***27 -*** 36 | | | pg |
| MCHC | ***320 -*** 360 | | | g/l |
| PLT | ***140 -*** 400 | | | /nl |
| ESR (VS) | | ***< 22*** | **<** 24 | mm/h |

*Remarks :*

- *RBC, HB ,HCT and ESR (VS) are the only parameters that vary according to gender*
- *Normal values depend on the measurement method, the reagents used and the automate! → There may therefore be some variability in the normal values for different automates even if they use the same measurement principle.*

## Educational tool 2: Scientific poster

**Instructions :**

1. **The poster must attract attention; it's a visual communication medium.**
2. **The poster is used to get a message across -> it's an illustrated summary**
3. **Format: A0 (118x84.4 cm or 120x80 cm)**

Write the text large enough.

Write as few words as possible (not a continuous text)

⇨ Choosing the right words

Build the poster from top left to bottom right

Distinguishing between different zones

Use explicit titles to guide you through the poster

Insert figures (images, graphs, tables, illustrative drawings, etc.). Each figure must have a caption.

# Teaching aid 3: Corrective measures

## Case 1

### 1) Description of a blood smear and digital microscope analysis

A blood smear is an examination in which a sample of blood is taken to analyse the quality and quantity of blood cells (assess the appearance and number of blood cells). This analysis may be prescribed specifically but is usually carried out immediately after any abnormalities in the complete blood count have been obtained by an automated system.

The drop of blood is spread out evenly on a microscope slide to form a single layer of cells. A staining technique is then used to distinguish the different cell types. This is generally the May-Grünwald Giemsa (MGG) stain, sometimes known as the Pappenheim stain. Once stained, the blood smear is then analysed under a microscope by a medical biologist or laboratory technician. He or she carries out a morphological analysis of the figurative elements in the blood and determines whether there are any abnormalities in the presence, appearance or number of cells.

The results will indicate whether your blood cells look normal or not. Results are given separately for red blood cells, white blood cells and platelets.

*Interpretation of red blood cell data*

Red blood cells are considered normal and mature when they are uniform, round, flattened, with hollow sides, and 7 µm in diameter. On a blood smear, these red blood cells appear pinkish in colour with a lighter centre. If these parameters differ, abnormalities can be identified. There are two types of red blood cell abnormality:

- **Size abnormalities**, more commonly known as anisocytosis, which are characterised by red blood cells with a smaller than average diameter (microcytes with a diameter of less than 7 µm) or larger than average diameter (macrocytes with a diameter of more than 7 µm).
- **Shape abnormalities**, also known as poikilocytosis, which are characterised by variations in the shape of the red blood cells: sea urchin-shaped (echinocytes), oval-shaped (elliptocytes or ovalocytes), larva-shaped (dacrocytes), sickle-shaped (sickle cells).

*Interpretation of white blood cell data*

An increase in certain white blood cells can identify the development of inflammation or disease. Among the different types of white blood cells, this is particularly the case :

- **Polynuclear neutrophils, which are** the type of white blood cells most commonly found in healthy adults and whose numbers increase during inflammation.
- **Eosinophilic polymorphonuclear cells, which are** few in number but increase in number in the event of allergies or infection by parasites.

- **Basophil polynuclear cells, which are** the least common type of white blood cell and whose rare increase generally occurs after vaccination, in chickenpox, ulcerative colitis or certain leukaemias.
- **Monocytes, the** largest white blood cells.
- **Lymphoid cells**, which include lymphocytes, a subclass of white blood cells involved in defending the body.

*Interpretation of platelet data*

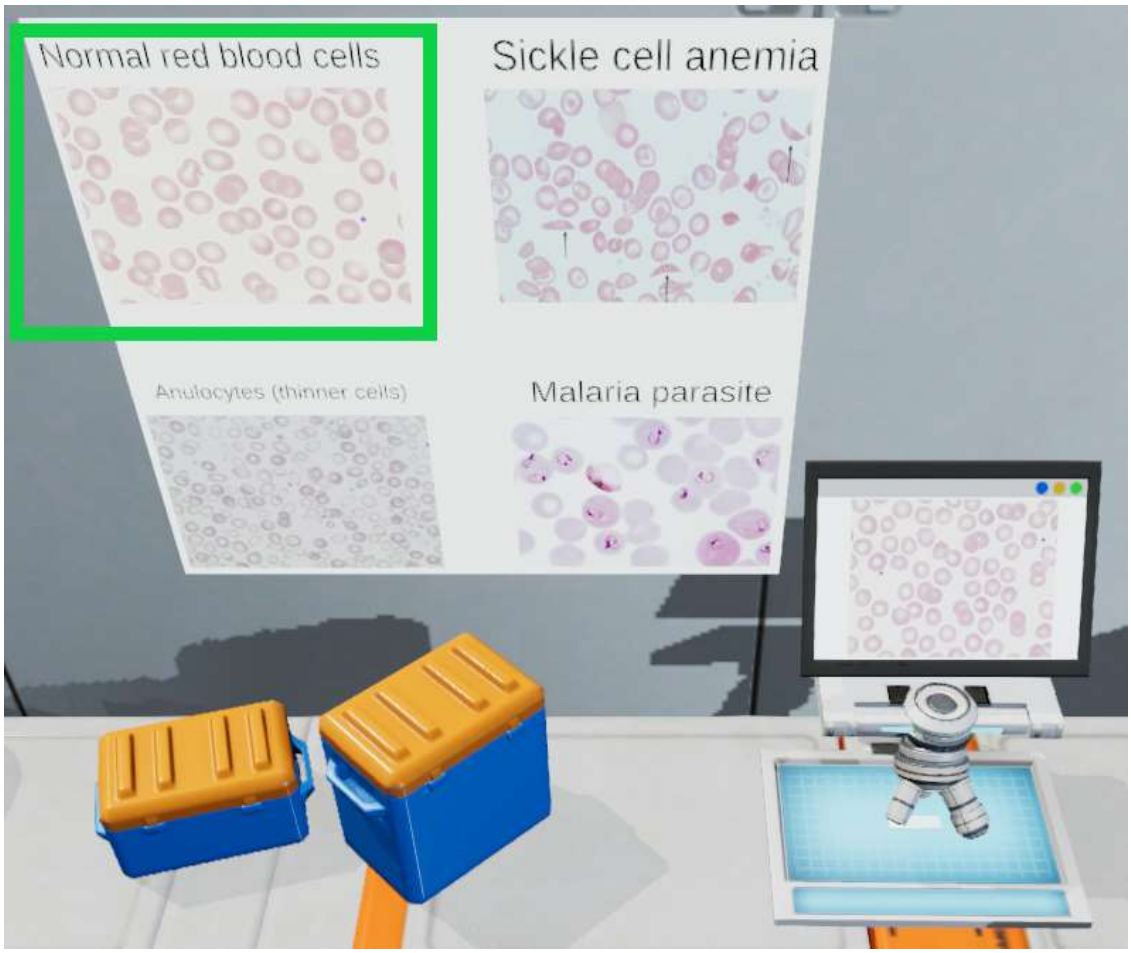
A blood smear is used to assess the number of platelets in the blood. Too few or too many platelets can lead to serious complications. Platelets are involved in the coagulation process and must be present in sufficient quantity to stop bleeding. While an insufficient quantity of platelets alters the coagulation process, too many platelets can lead to the formation of blood clots and reduce the fluidity of the blood.

**A digital microscope** is a microscope that uses a digital camera instead of an eyepiece. Digital microscopes connect to a computer screen to display results in real time. A digital microscope can perform the same tasks as an optical microscope, but has certain advantages:

- More comfortable for the TLM: sample observed on a screen instead of looking through an eyepiece
- Magnification level can be higher
- Superior image quality: because it projects the image directly onto the camera, better contrast
- Image storage: images can be saved on the computer's hard disk or on a storage device.
- Ease of use

## 2) Analysis results

- Result for red blood cells of the digital microscope analysis of the blood smear from your sample




## 3) Observations and interpretation :

By comparing the digital microscope analysis of the blood smear from our sample with the reference images, we can see that our smear corresponds to the "normal red blood cells" blood smear.

Red blood cells are uniform, round and flattened, with hollow sides. The red blood cells appear pinkish in colour with a lighter centre. We are therefore dealing with normal, mature RBCs.

Our sample therefore corresponds to a non-pathological sample.

## 4) What is anaemia?

Anaemia is an abnormal drop in haemoglobin levels in the blood due to a lack or malfunction of red blood cells, resulting in a reduced flow of oxygen to the body's organs. The disease is therefore characterised by a shortage of healthy red blood cells.

Symptoms may include fatigue, pale skin, shortness of breath, dizziness and rapid heartbeat. Treatment depends on the underlying diagnosis. Iron supplements can be used for iron deficiency, vitamin B supplements for low vitamin levels, blood transfusions for blood loss, and blood-forming drugs if the body's blood production is reduced.

Since a diagnosis cannot be made on the basis of symptoms alone, it is necessary to carry out a laboratory examination of a blood sample: a haemogram, i.e. a complete blood count and a blood smear.

Here are the 3 main parameters analysed during the haemogram:

- Haemoglobin level (HB)

The concentration of haemoglobin, the respiratory pigment contained in red blood cells, in the blood, expressed in grams of haemoglobin per litre of blood (g/l) or per 100 ml of blood (g/100 ml or g/dl).

- Haematocrit level (HCT)

The ratio, expressed as a percentage, of the volume occupied by the red blood cells in a blood sample passed through a centrifuge to the total volume of blood in the sample.

- Red blood cell (RBC) count

The number of red blood cells contained in a given volume of blood, normally expressed in millions of red blood cells per microlitre of blood (million/µl).

The blood smear can identify damage to RBCs by finding fragments of RBCs, portions of ruptured cells, or evidence of significant alterations to the membrane of sickle cells or oval-shaped cells. The blood smear can also reveal variations in the shape and size of red blood cells.

**5) What would the red blood cells in a blood smear look like in the presence of anaemia? Explain**

In anaemia, the red blood cells have different shapes and colours. The smear would resemble the "sickle cell anemia" reference image: the red blood cells would be deformed and look like sickles.

**9) Is there a suspicion of fraud (falsification of the identity (sex) of the person) for this sample? Explain**

No, there is no suspicion of fraud. In any case, with this type of analysis, it's not possible to raise any suspicions.

## Case 2

### 1) Description of a haemogram (definition, objectives, analyses carried out, measurements, assays, etc.)

The haemogram, also known as the complete blood count (CBC) or complete haematological examination (complete haematology), is the quantitative (count) and qualitative (count) analysis of the figurative elements of the blood: red blood cells (haemocytes), white blood cells (leukocytes) and platelets (thrombocytes).

Nowadays, the analysis is carried out by an automated medical analysis system, using samples taken during a blood test and preserved with an anticoagulant.

The analysis machine directly measures the number of erythrocytes (also known as the haematocyte or blood cell count), the mean corpuscular volume (MCV) of each of them and doses the haemoglobin level. It then calculates the haematocrit (ratio represented by all the red blood cells in the blood), the mean corpuscular haemoglobin concentration (MCHC) and the mean corpuscular haemoglobin content (MCHC), a parameter of less importance.

The results of the haemogram vary physiologically according to sex, age and ethnic group. The analysis must be interpreted by a qualified person, taking into account the medical context.

Only the number of red blood cells, the number of white blood cells, the haemoglobin level and the haematocrit are measured in the haemogram. The other values are only deduced. Non-standard values can be used to detect specific haematological infections, as well as the blood expression of other illnesses: in particular infections, various deficiencies, certain cancers, etc.

Analysis of the erythrocyte constants - VGM, MCHC and MCH - is useful and enables the doctor to suspect the cause of the anaemia. Anaemia is defined as a haemoglobin level below the norm.

### 2) What is the sedimentation rate?

The sedimentation rate (ESR) is a test that measures the rate of sedimentation or free fall of red blood cells (RBCs) in a sample of blood left in a vertical tube after one hour.

This speed depends on the concentration of proteins in the blood. It varies in the event of inflammation, when levels of inflammatory proteins, fibrinogen or immunoglobulins increase. It is therefore generally used as a marker of inflammation.

This test is often prescribed at the same time as the haemogram or blood count.

This test is rapid and inexpensive, but not very specific.

The result is expressed in millimetres after one hour. The sedimentation rate varies according to :

- gender: it is faster in women than in men;
- age: it is more rapid in older people than in younger subjects.

When the sedimentation rate is increased, the person may be suffering from :

- infection;
- malignant tumour;
- multiple myeloma ;
- chronic kidney disease;
- inflammatory disease;
- anaemia;

On the contrary, a decrease in sedimentation rate may be observed in cases of :

- haemolysis, i.e. abnormal destruction of red blood cells;
- hypofibrinemia or reduced fibrinogen levels ;
- polycythemia, which prevents sedimentation;
- taking certain high-dose anti-inflammatory drugs;
- etc.

In cases where the sedimentation rate is moderately high, for example between 20 and 40 mm/h, the test is not very specific and it is difficult to confirm the presence of inflammation. Other tests will probably be required.

### 3) Analysis results

- Haemogram of a healthy person[1]

| PARAM | VALUE | MALE RANGES | FEMALE RANGES |
|---|---|---|---|
| WBC | 4,8 /nL | 4 /nL - 10 /nL | 4 /nL - 10 /nL |
| RBC | 5,7 /pL | 4,4 /pL - 6,0 /pL | 4,2 /pL - 5,5 /pL |
| HB | 163,2 g/L | 140 g/L - 180 g/L | 120 g/L - 160 g/L |
| HCT | 48,2% | 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 |

- Blood count of your sample[1]

Sample ID: 210432863
Demographic: Male 35 y/o
Requested Analysis:
- Hematology CBC

| 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 |

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

- Annexes A and B

**4) Comments :**

**Does the healthy person's haemogram come from a man or a woman? Please explain.**

By comparison with the data in Appendix B, the values for RBC, HB and HCT (which reflect the red blood cell line and vary according to sex) correspond to the values for a man.

**In the haemogram of your sample, why do some parameters appear in red? Please explain.**

The parameters shown in red are those whose values do not correspond to normal values. They therefore point to a potential pathology.

**5) Interpretation and conclusion :**

The abnormal parameters were RBC, HB and HCT. The analysis shows that the haemoglobin level is reduced, and that the red blood cell count and haematocrit are also below the reference values (for a man).

➔ We are therefore in the case of **anaemia**

Analysis of the sedimentation rate (ESR) also shows an abnormality. The sedimentation rate is higher than the threshold for a man, which is < 22 mm/h. An increased sedimentation rate may reflect the presence of an infection or inflammation.

However, in the case of anaemia, an increase in the SV may be observed without it reflecting inflammation or infection. But this increase in the SV during anaemia is not systematic!

➔ an additional microbiological analysis may be requested to determine the presence or absence of inflammation or infection.

**6) Is there a suspicion of fraud (falsification of the identity (sex) of the person) for this sample? Explain**

No, there is no suspicion of fraud. In fact, the results are consistent for a man with a medical condition (in this case anaemia).

*Remark: If the person's identity had been falsified (a woman instead of a man), the pathological parameters would have been in the same direction and would have highlighted the same pathology. So there's no point in falsifying the person's identity!*

## Case 3

### 1) Analysis results

- Haemogram of a healthy person[1]

| PARAM | VALUE | MALE RANGES | FEMALE RANGES |
|---|---|---|---|
| WBC | 4,8 /nL | 4 /nL - 10 /nL | 4 /nL - 10 /nL |
| RBC | 5,7 /pL | 4,4 /pL - 6,0 /pL | 4,2 /pL - 5,5 /pL |
| HB | 163,2 g/L | 140 g/L - 180 g/L | 120 g/L - 160 g/L |
| HCT | 48,2% | 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 |

- Blood count of your sample[1]

Sample ID: 220689321
Demographic: Female 23 y/o
Requested Analysis:
- Hematology CBC

| 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 |

- Annexes A and B

**2) Comments :**

**Does the healthy person's haemogram come from a man or a woman? Please explain.**

By comparison with the data in Appendix B, the values for RBC, HB and HCT (which reflect the red blood cell line and vary according to sex) correspond to the values for a man.

**In the haemogram of your sample, why do some parameters appear in red? Please explain.**

The parameters shown in red are those whose values do not correspond to normal values. They therefore point to a potential pathology.

**3) Interpretation based on analysis of the blood count of your sample :**

The abnormal parameters were HB and HCT. The analysis shows that the haemoglobin and haematocrit levels exceed the reference values (for a woman). However, the red blood cell count was correct.

An **elevated haemoglobin level** may be found in people who :

- live at high altitude or among smokers.
- Dehydration, which can also lead to falsely elevated haemoglobin that returns to normal with rehydration
- Take EPO (Erythropoietin = hormone which increases the number of circulating red blood cells, thereby increasing the capacity to transport oxygen to the tissues, and in particular to the muscles, which are major consumers of oxygen during exercise).
- Have a serious disease: polycythaemia or erythrocytosis, which is an increase in the mass of red blood cells and is associated with an increase in haemoglobin concentration (Hb) and haematocrit (HCT).

The sedimentation rate (ESR or VS) is 12 mm/h, which is normal for a woman. The normal SV for a woman is < 24 mm/h.

➔ no suspicion of inflammation or infection on the basis of haematological tests.

**4) Description of a urinalysis (by tigette)**

Urinalysis is used to detect infections of the urinary tract (urethra, bladder, kidneys) or kidney disease, or to help diagnose diseases that affect the whole body (systemic), such as diabetes.

Urinalysis can be carried out in a number of ways:

- by dipping a test strip or dip stick into the urine. The colour of the tigette is then compared with a standard tigette. The colouring provides information on the degree of acidity (pH), chemical changes (presence of sugar, nitrites, proteins, etc.) and the presence of red and white blood cells.
- by examining, under a microscope, urine that has been centrifuged for 5 minutes in a test tube. Centrifugation precipitates all the cells and other components of the urine to the bottom of the tube. This precipitate is then examined under the microscope.
- The culture of bacteria present in urine is only useful if there is a suspicion of infection. The bacteria are grown in a special culture medium and identified in the laboratory. The effectiveness of antibiotics against the germs detected is then tested.
- cytological analysis examines the malignant nature of the cells found in the urine.

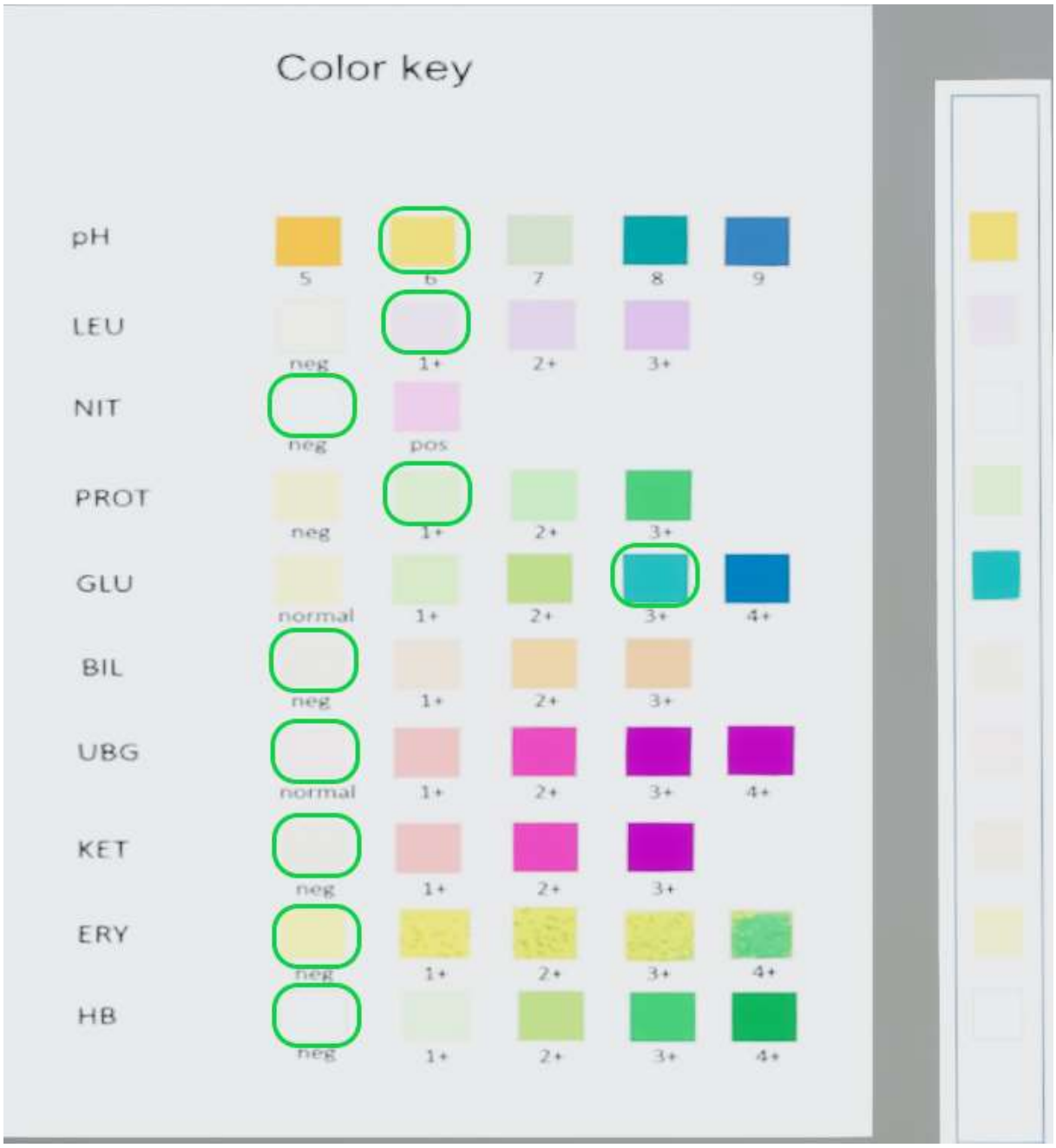
The doctor will decide which test is most appropriate, depending on your symptoms. In principle, he will always start with a test strip and a microscopic examination.

**Urine analysis using tigettes** is one of the most frequent analyses. It can reveal urogenital infections, as well as various metabolic, liver and kidney disorders.

The test consists of a tigette with reactive zones to detect the presence of various elements in the urine, such as nitrites, proteins, glucose, ketone bodies, urobilinogen and bilirubin, as well as density and pH.

| **Interpretation of a urine test strip** | | |
|---|---|---|
| Leukocytes | 10 leukocytes / µl | Infections |
| Nitrites | 0.3 mg/L | Enterobacteriaceae infections |
| pH | 5,0 | Kidney stones |
| Proteins | 60 mg/L (albumin) | Renal dysfunction |
| Glucose | 0.4 g/L | Diabetes |
| Ketone bodies | 0.05 g/L | Diabetes |
| Urobilinogen | 4 mg/L | Diseases of the liver and biliary tract |
| Bilirubin | 84 mg/L | Diseases of the liver and biliary tract |
| Specific weight | 1.0 kg/L | Renal dysfunction |

**5) Results of the urinary analysis (by tigette) of your sample**




**6) Observations and interpretation based on the urinary analysis of your sample :**

The urine dipstick shows the significant presence of leucocytes, proteins and glucose in the urine.

- **Presence of leukocytes (LEU)** but not in sufficient quantity to indicate infection.
  In order to identify a urinary tract infection (cystitis or pyelonephritis), which may be caused by bacteria, mycoplasma, microscopic fungi, etc., there must be a very high number of leukocytes in the urine (more than 10,000 per ml of urine).
  ➔ To conclude that it was a urinary infection, the tigette would have had to be dark purple!

- **Presence of protein (PROT)** but not in sufficient quantity to indicate infection.

  It's normal for urine to contain a little protein. It is the kidneys that filter the amount of protein in the urine. The presence of a high concentration of protein in the urine would most often indicate a kidney anomaly or disease. This is not the case here.

  ➔ No sign of renal pathology!

- Too much **glucose (GLU).**

  ➔ Diabetes!

**7) Conclusion:**

Increased haemoglobin

Increased haematocrit

The sample would correspond to a person with diabetes.

**8) Is there a suspicion of fraud (falsification of the identity (sex) of the person) for this sample? Explain**

If there is a suspicion of identity fraud (a man instead of a woman), the parameters detected by the haemogram would lead to other conclusions:

- The haemoglobin (HB) level (172.0 g/L) is normal, as the reference range for a man is 140 to 180 g/L.

- The haematocrit level (HCT) (50%) is within the reference values, as the range is 40 to 54% in a man.

- The sedimentation rate (ESR or VS) in a man is < 22 mm/h. So a VS of 12 mm/h is normal. There are therefore no signs of inflammation or infection.

So if the patient is male, there are no pathologies detected on the basis of haematological analyses.

If there is any doubt that it may be a woman, haemoglobinaemia (high haemoglobin) and a high haematocrit level are observed.

## Teaching aid 4: Summary

**Medical analysis laboratory and the TLM business**

**Medical analysis laboratories are** general and specialised clinical biology units. They deal with all types of request (routine check-ups, diagnosis, follow-up) for all types of patient. Samples are taken on site, in dedicated sampling centres or at home.

The samples analysed in an analysis laboratory include blood tubes, urine, faeces, cerebrospinal fluid, nasopharyngeal swabs, vaginal smears, etc.: in short, various biological fluids of human origin that can be analysed.

Medical analysis laboratories cover a number of different areas of analysis:

- microbiology: a field of applied science concerned with the study of micro-organisms and the activities that characterise them.
- clinical chemistry: study of the concentration of numerous molecules (analytes) of interest in plasma and/or serum blood.
- haematology: the science that studies blood and its diseases. More specifically, it studies blood cells, immunity and coagulation.
- molecular biology: study of nucleic acids (DNA, RNA)
- and in some cases anatomopathology/histology: the study of tissues and their preparation for laboratory analysis.

These biological samples for biomedical analysis, as prescribed by a doctor for diagnosis, screening, treatment, prevention or research purposes, are taken and processed by **Laboratory Technologists (MLTs),** who can take specific biological samples (blood, secretions, etc.).

Laboratories are highly automated and include what are known as "automatons": these are "machines" that carry out medical analyses autonomously in order to process samples more quickly (than if the analyses were carried out manually) and to handle larger quantities. This enables hospital laboratories to process analyses more quickly and deliver results in a very

short time. In fact, the results obtained following analysis in a medical laboratory are given to prescribers within a short timeframe, the same day for emergency parameters.

*Haematology laboratory* :

Haematology is the medical speciality concerned with the elements that make up blood (red and white blood cells, platelets) and the associated pathologies (haemopathies).

The haematology laboratory carries out routine activities, i.e. cytology tests (blood counts and formulae) and haemostasis tests (coagulation and monitoring of anticoagulant treatments).

In the haematology laboratory, what are known as "haemograms" are very often carried out, also known as blood count (CBC), complete blood count (CBC), or complete haematological examination (complete haemato). This is a quantitative (count) and qualitative (formula) analysis of the blood's figurative elements: red blood cells (or erythrocytes), white blood cells (leukocytes) and platelets (thrombocytes).

## 2. Media education activity

### Target skills

As part of this teaching activity, your pupils have used video games as a learning tool. When media education is introduced, it is interesting to propose a **media education** activity: getting the pupils to question the use of the medium itself: the reliability of the information, the message conveyed by the work, the ideological and societal issues linked to the use of this work.

With this in mind, we're offering you a questionnaire to give to your pupils at the end of the activity. It allows pupils to take a step back, debrief and discuss their perceptions and the way in which they experienced the game. It also questions their use of the medium in order to stimulate their reflexivity and critical thinking.

### Methodology

The FUNFORLAB "Point & Click" game focuses on three areas of media education:

-The ideology of the work: what message does the video game convey to the player? How does it portray the future? (on the profession of medical laboratory technologist, but also on the issues of climate change and ecology, the dystopian dimension, etc.).

-The educational aspect of the work: How did you experience the video game in class? What did you learn? Did you find it difficult to play the game? (reflective approach to the player's experience, questions about the digital divide and the different levels of digital skills of players).

-Reliability of information: are the elements presented in the game scientifically valid? Who created this game? Is it a reliable source and why (stimulating players' critical thinking about the reliability of information and checking sources)?

## Course and duration

**30 min** in a science course (**biology**) or a media education course

## Prerequisites

- Have played the FunForLab Point and Click game

# Activity sequence

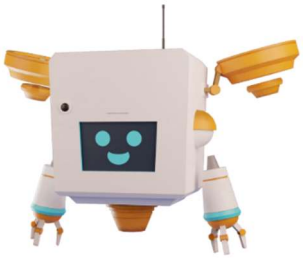
Each teacher is free to adapt or modify this proposal according to his or her own identity, school context and professional experience.

-Each student answers questions 1 to 5 individually (10 minutes)

-Place the pupils in a circle and set up a moment of debate during which the pupils can exchange ideas, proposing questions arising from the three areas of media education detailed below. (15 minutes)

-Each student responds individually to question 6 by drawing a picture: what have I learnt from this activity? (5 minutes)

# Teaching aid 5: Media literacy questionnaire



Hello dear student, you have just taken part in an educational activity involving a video game. We're going to ask you to answer a few questions that will help you to think about your experience.

1. What do you think is the message of this game?

.....

.....

.....

2. Which elements of the "Point and Click" video game seem realistic to you? Which elements are less realistic or purely fictional?

.....

.....

.....

3. Is the information presented in the game scientifically valid? How can we check this?

.....

.....

.....

4. How do the media influence our understanding of science? Can you give some concrete examples of how the media can shape our perception of scientific subjects?

.....

.....

.....

5. In your opinion, what are the advantages and limitations of using video games to learn science? Has it made you want to explore these subjects further outside the game?

.....

.....

.....

6. What do you take away from this activity? Answer this question in the form of a drawing (summarising your thoughts, presenting certain elements, taking elements from the questionnaire, etc.). Don't be afraid to be creative!