Canadian Lab Notes

Canadian MLT Exam Prep

THE HOLY SHEET

High-Yield Canadian MLT Study Guide

Designed for CSMLS & CAMLPR Exam Preparation

Digital Study Guide

Questions? Contact: | hello@canadianlabnotes.ca

THE HOLY SHEET

Clinical Chemistry

Quick Reference Guide

High-yield
Must-know facts for exam success

Easy to scan
Clear, concise, exam-focused

CSMLS / CAMLPR review
Built for the Canadian lab professional

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Your lab success starts here.

Covers Core Clinical Chemistry
Essential concepts made simple

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THE HOLY SHEET

Clinical Chemistry

Carbohydrates & Diabetes

A Carbohydrate Basics

Type	Definition	Examples
Monosaccharide	one sugar unit	glucose, fructose, galactose
Disaccharide	two sugar units	sucrose, lactose, maltose
Polysaccharide	many sugar units	glycogen, starch

Only monosaccharides are absorbed through the intestine.

B Glucose Pathways

- **Glycolysis:** breaks glucose down for energy
- **Glycogenesis:** stores glucose as glycogen
- **Glycogenolysis:** breaks glycogen into glucose
- **Gluconeogenesis:** makes new glucose from non-carbs
- **Pentose phosphate pathway:** produces NADPH; protects RBCs

C Insulin vs Glucagon

	Insulin	Glucagon
Released when:	glucose high	glucose low
Main effect:	lowers glucose	raises glucose
Source:	pancreatic beta cells	pancreatic alpha cells

Insulin stores. Glucagon gives.

D Specimens + Testing

- Gray-top tube contains sodium fluoride; inhibits glycolysis
- Delayed separation falsely lowers glucose
- Whole blood glucose is lower than plasma
- CSF glucose is about 60% of plasma
- Hexokinase = reference glucose method
- Glucose oxidase = produces hydrogen peroxide

E Diabetes Quick Review

- Fasting plasma glucose ≥ 7.0 mmol/L = diabetes
- **2-hour OGTT** ≥ 11.1 mmol/L = diabetes
- **HbA1c** ≥ 6.5% = diabetes
- **Type 1** = absolute insulin deficiency
- **Type 2** = insulin resistance
- **DKA:** ketones + acidosis
- **HHS:** severe hyperglycemia + hyperosmolality, minimal ketones
- **HbA1c** reflects 2–3 months; fructosamine reflects 1–3 weeks

Exam Tip

Gray-top tube preserves glucose by slowing glycolysis.

Watch Out

Nitroprusside detects mainly acetoacetate, not beta-hydroxybutyrate.

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THE HOLY SHEET

Clinical Chemistry

Carbohydrates & Diabetes

Part 1

A Carbohydrate Basics

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Disaccharide	two sugar units	sucrose, lactose, maltose
Polysaccharide	many sugar units	glycogen, starch

Only monosaccharides are absorbed through the intestine.

B Disaccharides & Digestion

- **sucrose → glucose + fructose**
  by sucrase
- **lactose → glucose + galactose**
  by lactase
- **maltose → glucose + glucose**
  by maltase

Only monosaccharides are absorbed through the intestine.

C Glucose Pathways

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	Insulin	Glucagon
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Insulin stores. Glucagon gives.

E Quick Pearls

Insulin stores. Glucagon gives.

No lactase = lactose lingers.

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CANADIAN LAB NOTES

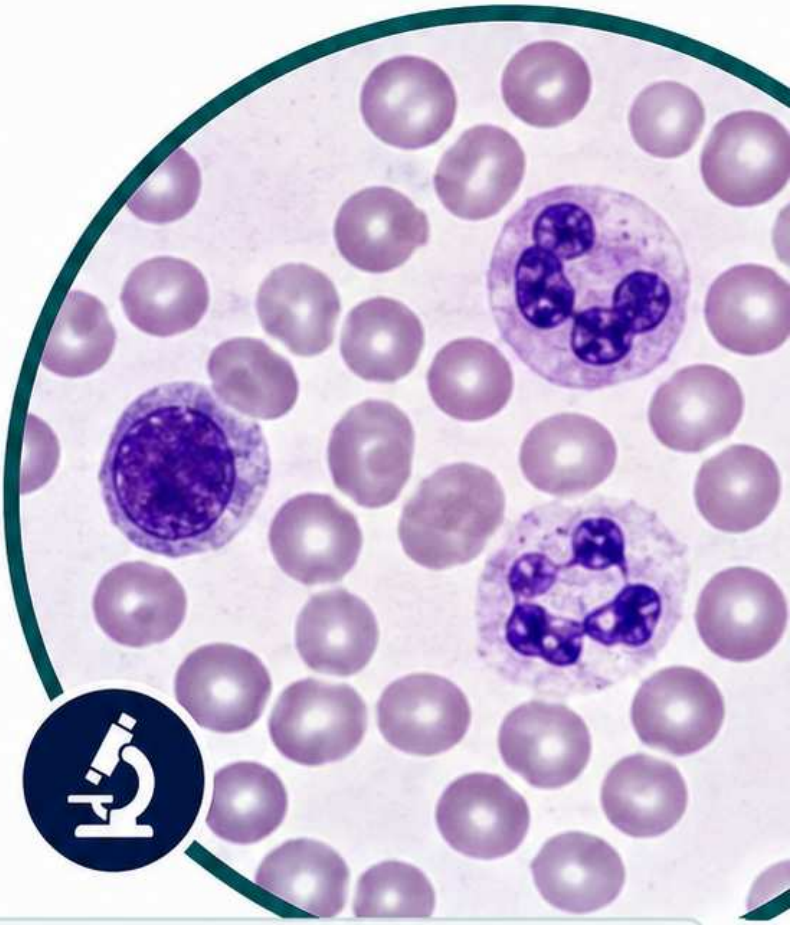
THE HOLY SHEET

Hematology

Canadian MLT Quick Reference Guide

High-yield hematology concepts you actually need to know.

- ESSENTIAL CONCEPTS
- CELL LINES & MORPHOLOGY
- LAB TESTS & INTERPRETATION
- CLINICAL APPLICATIONS



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THE HOLY SHEET

Hematology

Anemia Foundations: What the CBC Is Telling You

Anemia

A decrease in hemoglobin concentration below the laboratory reference interval. Often accompanied by low hematocrit and/or reduced RBC count.

Key Points

- Hemoglobin is the primary indicator.
- Severity depends on the degree of hemoglobin reduction and clinical context.
- Symptoms reflect decreased oxygen delivery (e.g., fatigue, pallor, dyspnea, tachycardia).

Polycythemia

An increase in RBC count and/or hematocrit above the laboratory reference interval.

Key Points

- May be relative (dehydration) or absolute (true increase in red cell mass).
- Absolute causes include primary (e.g., polycythemia vera) or secondary (e.g., chronic hypoxia, EPO-secreting tumors).
- Risk: hyperviscosity, thrombosis.

Absolute Anemia vs Relative Anemia

Feature	Absolute Anemia	Relative Anemia
RBC Mass	Decreased	Normal
Plasma Volume	Normal or increased	Decreased
Hemoglobin / Hematocrit	Decreased	Decreased (appears low due to less plasma)
RBC Count	Decreased	Normal
Examples	Iron deficiency, hemolysis, blood loss	Dehydration, burns, diuretics

The 3 Main Mechanisms of Absolute Anemia

1 Decreased or Ineffective Erythropoiesis

- Inadequate production of RBCs in the bone marrow.
- Causes: iron deficiency, B12/folate deficiency, chronic disease, kidney disease (↓ EPO), aplastic anemia, marrow infiltration.
- Reticulocyte count: low.

2 Increased Hemolysis

- Shortened RBC survival due to destruction.
- Causes: autoimmune, hereditary (e.g., G6PD deficiency, spherocytosis), infections, toxins.
- Reticulocyte count: high.

3 Blood Loss

- Loss of RBCs exceeds marrow replacement.
- Causes: acute hemorrhage, chronic GI loss, heavy menses, trauma.
- Reticulocyte count: high (after initial lag).

Memory Hook

Production low, destruction high, or blood loss.

Exam Tip

RBC mass and plasma volume measurements help distinguish absolute from relative changes.

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THE HOLY SHEET

Hematology

RBC Clues: Indices, Size, Colour & Shape

Morphologic Classification of RBC Patterns

Use size, colour, and indices together to interpret causes of anemia.

HYPOCHROMIC

↓ Hemoglobin in RBCs

Causes

- Iron deficiency
- Thalassemias
- Anemia of chronic disease
- Sideroblastic anemia
- Lead poisoning

Index Clues

↓ MCH, ↓ MCHC, often ↓ MCV

MACROCYTIC

↑ RBC Size

Causes

- Vitamin B_{12} deficiency
- Folate deficiency
- Liver disease
- Hypothyroidism
- Alcoholism
- Reticulocytosis
- Drugs (e.g., hydroxyurea)

Index Clues

↑ MCV, normal or ↑ MCH

NORMOCYTIC / NORMOCHROMIC

Normal size & colour

Causes

- Acute blood loss
- Hemolytic anemia
- Anemia of chronic disease
- Early iron deficiency
- Aplastic anemia

Index Clues

Normal MCV, MCH, MCHC

HEMOLYTIC PATTERN

Increased RBC destruction

Causes

- Hereditary spherocytosis
- G6PD deficiency
- Autoimmune hemolysis
- Microangiopathic processes
- Infections

Index Clues

Variable; often reticulocytosis

RBC Indices

Index	What It Measures	Typical Range	Meaning
MCV	Mean Corpuscular Volume	80–100 fL	Average size of RBCs
MCH	Mean Corpuscular Hemoglobin	27–32 pg	Average hemoglobin mass per RBC
MCHC	Mean Corpuscular Hemoglobin Concentration	320–360 g/L	Average hemoglobin concentration in RBCs
RDW	Red Cell Distribution Width	~11.5–14.5%	Variation in RBC size (anisocytosis)

RBC Morphology Prediction

Decreased MCV	Predict microcytes (small RBCs)
Normal MCV	Predict normocytes (normal size)
Increased MCV	Predict macrocytes (large RBCs)
Decreased MCHC	Predict hypochromia (pale RBCs)

WATCH OUT

Lipemia can falsely increase MCHC.
High triglycerides cause light scattering and falsely elevated MCHC.

Cold agglutinins can falsely increase MCHC.
RBC clumping in the cold reduces measured plasma water, falsely raising MCHC.

Spherocytes can truly increase MCHC.
Spherocytes have decreased surface area relative to volume, increasing hemoglobin concentration.

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Histopathology

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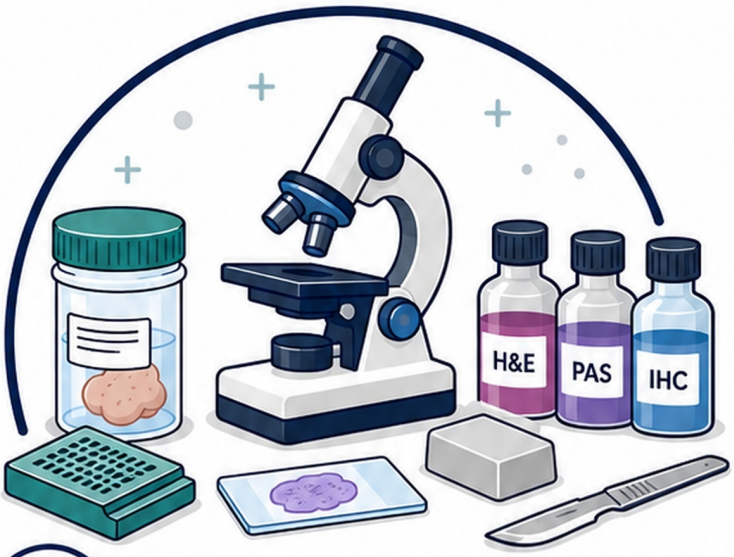

Canadian Lab Notes

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Cover Core Histopathology
Essential concepts made simple

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THE HOLY SHEET

Histopathology

Histopath Workflow Map

A Specimen Receipt

- Tissue arrives fresh or in fixative.
- Confirm patient identifiers, specimen source/site, laterality, and requisition details.
- Check whether special handling is required (frozen section, IF, EM, flow, molecular).

B Accessioning

- Enter the case in the LIS and assign a unique lab number.
- Maintain full traceability: container → cassette → block → slide → report.
- Resolve any mismatch before grossing.

C Grossing & Sampling

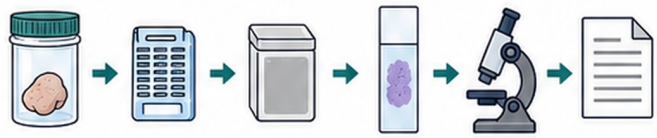
- Describe size, weight, colour, consistency, lesions, and margins.
- Select representative tissue.
- Keep pieces thin enough for fixation and processing.
- Tiny biopsies may need biopsy cassettes, sponges, or wraps.

D Processing Pathway

1. **Fixation** – preserves morphology
2. **Dehydration** – removes water
3. **Clearing** → replaces alcohol
4. **Infiltration** – adds paraffin support
5. **Embedding** – orient in wax
6. **Microtomy** – cut thin sections
7. **Staining** – H&E / special stains / IHC
8. **Review** – pathologist interpretation

E Workflow Pearls

- Errors early in the chain can appear later as bad sections or stains.
- Thick tissue can cause underfiixation and poor processing.
- Wrong orientation can hide the diagnostic surface.
- Histopath is a traceability workflow from receipt to report.



Exam Tip

If a slide looks wrong, think backward through the chain: fixation → processing → embedding → microtomy → staining.

Watch Out

Do not place tissue for special testing into routine formalin until protocol is confirmed.

Rapid Review

Receive → accession → gross → process → embed → cut → stain → review.

Questions? Contact: hello@canadianlabnotes.ca

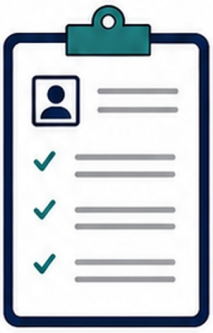
THE HOLY SHEET

Histopathology

Specimen Handling & Accessioning

A Requisition Check

- Match patient name and unique ID on the specimen and requisition.
- Confirm specimen source/site and laterality.
- Review clinical history and any requested tests.

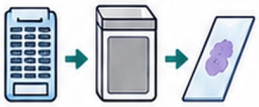


B Container & Tissue Status

- Verify whether the tissue arrives fresh or in fixative.
- Check the number of containers and specimen parts received.
- Pause if the label is missing, leaking, or incomplete.

C Accessioning Essentials

- Enter the case in the LIS and assign a unique case number.
- Label cassettes, blocks, and slides consistently.
- Maintain traceability from container → cassette → block → slide → report.



D Common Traps

- Wrong patient or wrong site.
- Missing source or laterality.
- Special-test tissue placed into routine formalin.
- Multiple parts not clearly separated.

E Quick Pearls

- Accessioning errors are patient-safety issues.
- Resolve mismatches before grossing.
- Special handling may be needed for frozen section, IF, EM, flow, or molecular testing.

Exam Tip

If the tissue history does not fit the request, stop and verify before accessioning.

Watch Out

Never assume the specimen source or laterality from the container alone.

Rapid Review

Check ID → confirm source → assess tissue status → accession in LIS → label all downstream items.

Questions? Contact: hello@canadianlabnotes.ca

MIC

THE HOLY SHEET

ID

Microbiology

Canadian MLT Quick Reference Guide

High-yield microbiology concepts you actually need to know.

Bench Mindset & Workflow

Think in order.
Work with purpose.

Organism ID Patterns

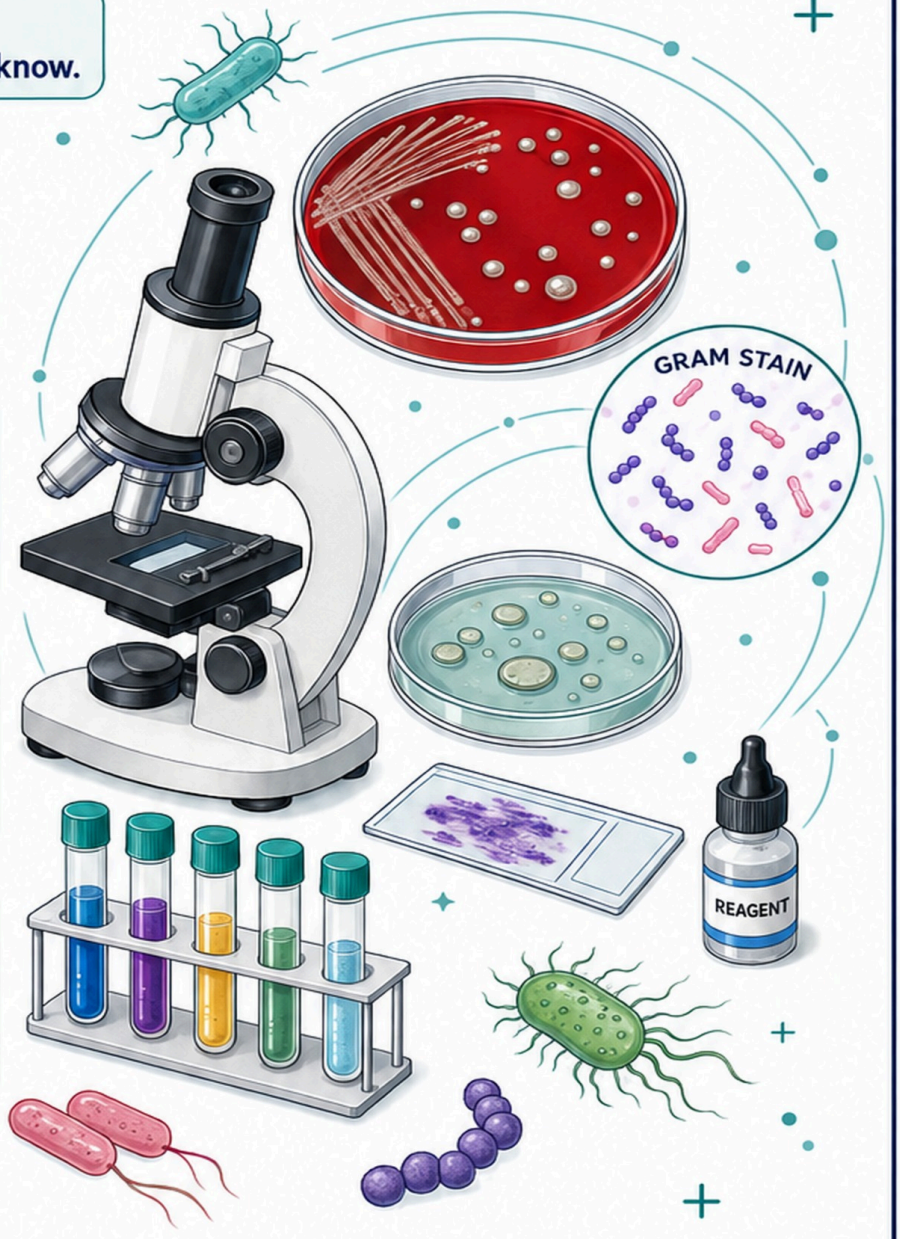
Spot the pattern.
Read the clues.

Culture, Media & Microscopy

Grow it. See it.
Understand it.

Specimen + Gram-Positive Cocci

Start smart.
Report with confidence.



High-yield and focused

Pattern-first learning

Memory anchors

Lab-ready confidence

Safe patients. Strong results.

Questions? Contact: hello@canadianlabnotes.ca

MIC

THE HOLY SHEET

Microbiology

Micro Bench Mindset

ID

BIG IDEA

Micro is not organism-name bingo.

Build the ID from specimen source + smear + culture + key tests.

1. Bench workflow - think in order

1. **Specimen source**
   What organism(s) are expected vs suspicious?
2. **Direct smear / Gram stain**
   Reaction and morphology guide the path.
3. **Culture growth**
   Media, atmosphere, hemolysis, colony look.
4. **Screening tests**
   Catalase, coagulase, oxidase, PYR, indole.
5. **ID + AST**
   Confirm the organism and report useful drugs.

2. Classic clue chains

GPC clusters	Staphylococcus group
GPC chains/pairs	Strep / Enterococcus
GNR + pink MAC	Enterobacterales LF direction
Oxidase+ GNR	*Pseudomonas* / fastidious
Alpha hemolysis	Viridans vs *S. pneumoniae*
No MAC growth	GP, fastidious, or inhibited

3. What to ask first

- Is this specimen sterile or colonized?
- Does the Gram stain match the plate?
- Is there a predominant organism?
- Is this likely infection, colonization, or contamination?
- Do I need AST, confirmation, or escalation?

4. Look-alike traps

Alpha strep →	Pneumo vs viridans
NLF on MAC →	Not always Salmonella
CoNS in blood →	Contaminant vs device infection
Candida sputum →	Usually colonization
PCR positive →	Not always active disease

5. One-clue ID is risky

Do NOT call an organism from:

- colony colour only
- one biochemical only
- source only
- Gram stain only
- AST pattern only

Confirm with the full pattern.

MICRO DECISION SHORTCUT

If you see...	Think first...	Next test / clue	Common trap
GPC clusters	Staph group	Catalase + coagulase	CoNS can matter
GPC chains	Strep / Enterococcus	Hemolysis + PYR/BEA	Enterococcus looks like Strep
Pink MAC GNR	Enterobacterales	Indole/citrate/urease	Not always *E. coli*
Oxidase+ NLF	Non-fermenter	Pigment, motility, source	Not a stool pathogen by default
Yeast in sputum	Colonization likely	Clinical context	Do not overcall pneumonia

EXAM PEARL

A good Micro answer is a chain, not a guess:
specimen source → Gram stain → culture pattern → key test → clinical significance.

When the result does not fit. STOP and rebuild the case.

MIC

THE HOLY SHEET

Microbiology

Gram Stain Fast Interpretation

ID

BIG IDEA — **A fast, accurate Gram stain connects what you see** to the likely organism, specimem source, and next test.

1 What to report mentally

1. **Gram reaction** — Purple (G+) or pink (G–)
2. **Shape** — Cocci, rods, curved, coccobacilli, yeast
3. **Arrangement** — Clusters, chains, pairs, singles, palisades, etc.
4. **Cells present** — Any WBCs, epithelial cells, yeast, others
5. **Quality** — Good, fair, poor smear; stain quality acceptable? Good / Fair / Poor

2 Gram stain quick clues

What you see	Most likely genera
Gram-positive cocci in clusters	*Staphylococcus*
Gram-positive cocci in chains	Streptococcus / Enterococcus
Gram-positive lancet diplococci	S. pneumoniae
Gram-positive rods with spores	Bacillus / Clostridium
Gram-positive branching rods	Actinomyces / Nocardia
Gram-negative diplococci	Neisseria / Moraxella
Gram-negative curved rods	Campylobacter / Vibrio
Gram-negative coccobacilli	Haemophilus / Acinetobacter
Yeast with budding	Candida-type thinking

3 Common Gram stain problems

Problem	Why it matters
Over-decolorization	Gram-positive may appear pink (false G–).
Under-decolorization	Gram-ıegative may appear purple (false G+).
Smear too thick	Poor decolorization, clumping, hard to read.
Smear too thin	Cells may wash off or look faint; hard to find.
Old culture	Dead cells, debris, or degraded morphology.
Antibiotic exposure	Low bacterial load, altered morphology.
Poor technique / reagents	Uneven stain, precipitate, misleading appearance.

4 When smear and culture do not match

- Was the specimen from the right site and time?
- Was the smear well prepared and stained?
- Could mixed flora or contamination be present?
- Could prior antibiotics or host factors explain it?

EXAM PEARL

A good Gram stain answer connects morphology with culture and specimen source.

What you see on the slide + What grows in culture + Where it came from = The right interpretation

Think pattern, not just names.

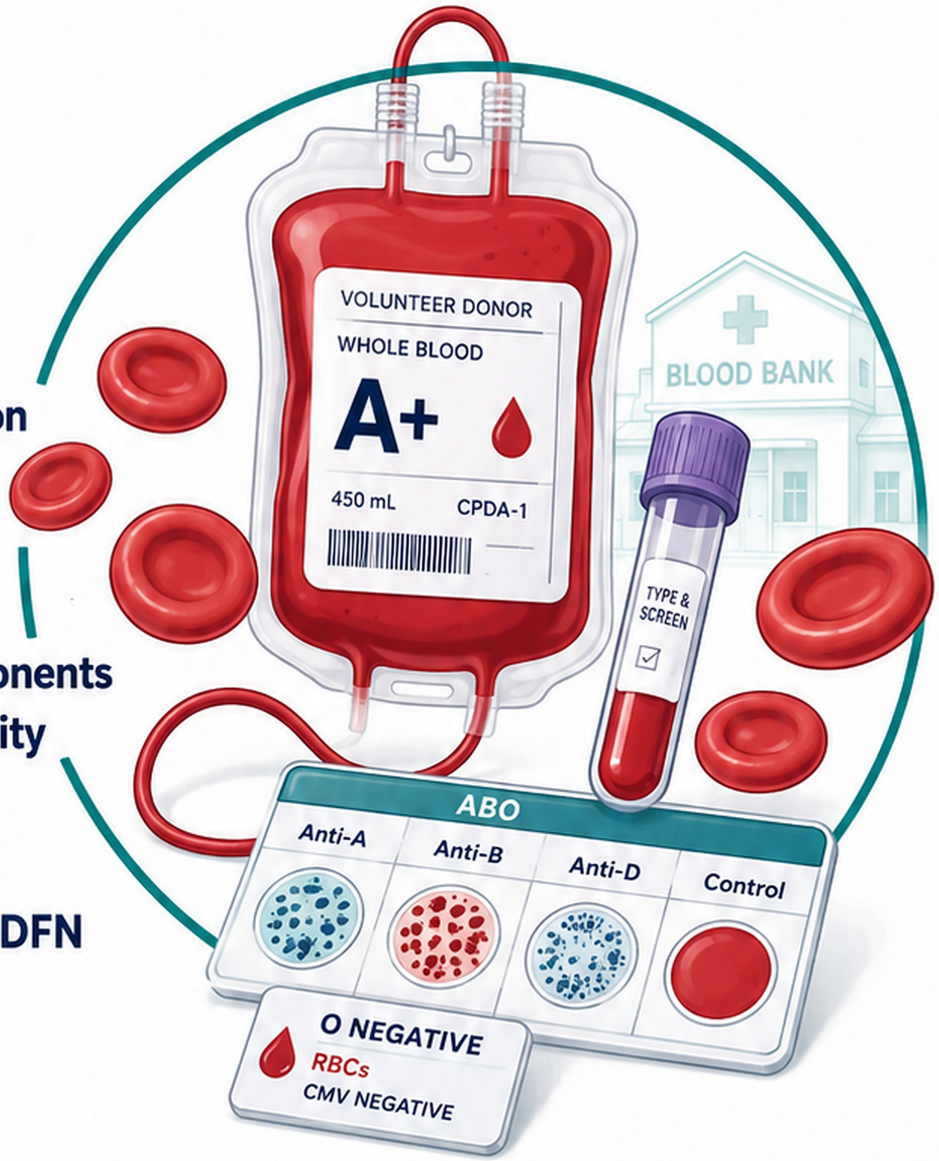
THE HOLY SHEET

Transfusion Medicine

Canadian MLT Quick Reference Guide

High-yield transfusion medicine concepts you actually need to know.

- **ABO & Rh Essentials**
- **Pretransfusion Testing**
- **Blood Components & Compatibility**
- **Reactions, HDFN & AIHA**



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THE HOLY SHEET

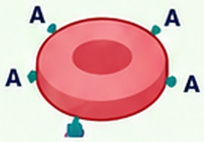
Transfusion Medicine

ABO Basics: Antigens, Antibodies & Landsteiner's Law

Big picture

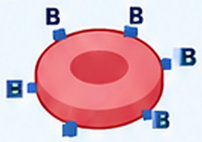
ABO testing is the foundation of transfusion safety: identify what is on the patient red cells (antigens) and what antibodies are in plasma.

A Group A



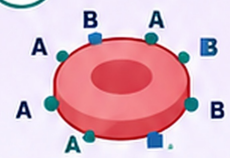
RBC antigen(s): A
Plasma antibodies: anti-B
Compatible RBC choice: A or O RBCs

B Group B



RBC antigen(s): B
Plasma antibodies: anti-A
Compatible RBC choice: B or O RBCs

AB Group AB



RBC antigen(s): A, B
Plasma antibodies: none
Compatible RBC choice: A, B, AB or O RBCs

O Group O

RBC antigen(s): none
Plasma antibodies: anti-A, anti-B
Compatible RBC choice: O RBCs only

Landsteiner's Law

People usually make naturally occurring antibodies against the ABO antigen(s) missing from their own red cells.

RBC has A	Missing B	Anti-B
RBC has B	Missing A	Anti-A
RBC lacks A/B	Missing A + B	Anti-A + Anti-B

Forward vs Reverse Grouping

Forward = patient cells + known antisera.
Reverse = patient plasma + known reagent cells.

ABO	Anti-A	Anti-B	A1 cells	B cells
A	+	-	-	+
B	-	+	+	-
AB	+	+	-	-
O	-	-	+	+

Why ABO Is So Dangerous

- Most ABO antibodies are naturally occurring.
- Many are IgM and can bind complement.
- ABO-incompatible RBCs can cause rapid intravascular hemolysis.
- Most catastrophic ABO errors start with clerical/specimen ID errors.

ABO Product Logic

RBC transfusion
Choose donor RBCs that lack antigens targeted by the recipient plasma antibodies.

Plasma transfusion
Choose donor plasma that does not contain antibodies against recipient RBC antigens.

Watch Out

Group O RBCs:
not for universal; not for Bombay phenotype.

AB plasma:
universal plasma donor because it lacks anti-A and anti-B.

Newborns:
do not usually get reverse grouping because antibodies are not reliable.

Mismatch?:
Do not report until discrepancy is investigated and history is checked.

Memory Hook

Cells show what you ARE. Plasma shows what you ATTACK.

Concept	Ask yourself	Main reagent	Positive reaction means
Forward group	What is on the RBC?	Anti-A / Anti-B	Corresponding antigen is present
Reverse group	What is in plasma?	A1 cells / B cells	Corresponding antibody is present
Compatibility	What could attack what?	Patient plasma vs donor cells	Incompatibility must be resolved

THE HOLY SHEET

Transfusion Medicine

BP Transfusion

Forward/Reverse Grouping + ABO Compatibility

Forward Grouping

- Patient cells + anti-A / anti-B reagents.
- Agglutination means the corresponding antigen is present on RBCs.
- Detects A and B antigens.

Reverse Grouping

- Patient plasma + A1 / B reagent cells.
- Agglutination means the corresponding antibody is present in plasma.
- Reciprocal check against forward type.
- Infants under ~4 months are not reliably reverse grouped.

ABO Compatibility — At a Glance

Patient Group	Compatible RBCs (What they can receive)	Compatible Plasma (What they can receive)	Typical Platelet Note (Plasma content matters)
A	A or O	A or AB	ABO identical preferred, flexibility depends on plasma volume / policy.
B	B or O	B or AB	ABO identical preferred, flexibility depends on plasma volume / policy.
AB	AB, A, B or O	AB only	ABO identical preferred, flexibility depends on plasma volume / policy.
O	O only	O, A, B or AB	ABO identical preferred, flexibility depends on plasma volume / policy.

Universal Donor / Recipient Pearls

O RBCs = Universal Donor
No A or B antigens on RBCs.

AB Plasma = Universal Donor
No anti-A or anti-B antibodies.

AB RBCs = Universal Recipient
No anti-A or anti-B antibodies.

O Plasma = Universal Recipient
No A or B antigens.

Common Pitfalls

Wrong blood in tube
Label at bedside. ID + 2 identifiers. Stop if unsure.

Historical type mismatch
Old records can be wrong. Always retype.

Reverse group in newborns
Maternal antibodies in plasma = unreliable results.

Cold antibodies
May cause false positives in reverse typing. Use warm techniques and investigate.

Memory Hook / Exam Tip

"Cells have Antigens → Plasma has Antibodies → Match or Attack!"

Forward: Look at CELLS (What antigens are there?)

Reverse: Look at PLASMA (What antibodies are there?)

Compatibility: Match what's GIVEN to what's ACCEPTED.

When in doubt, STOP, CHECK, and VERIFY.