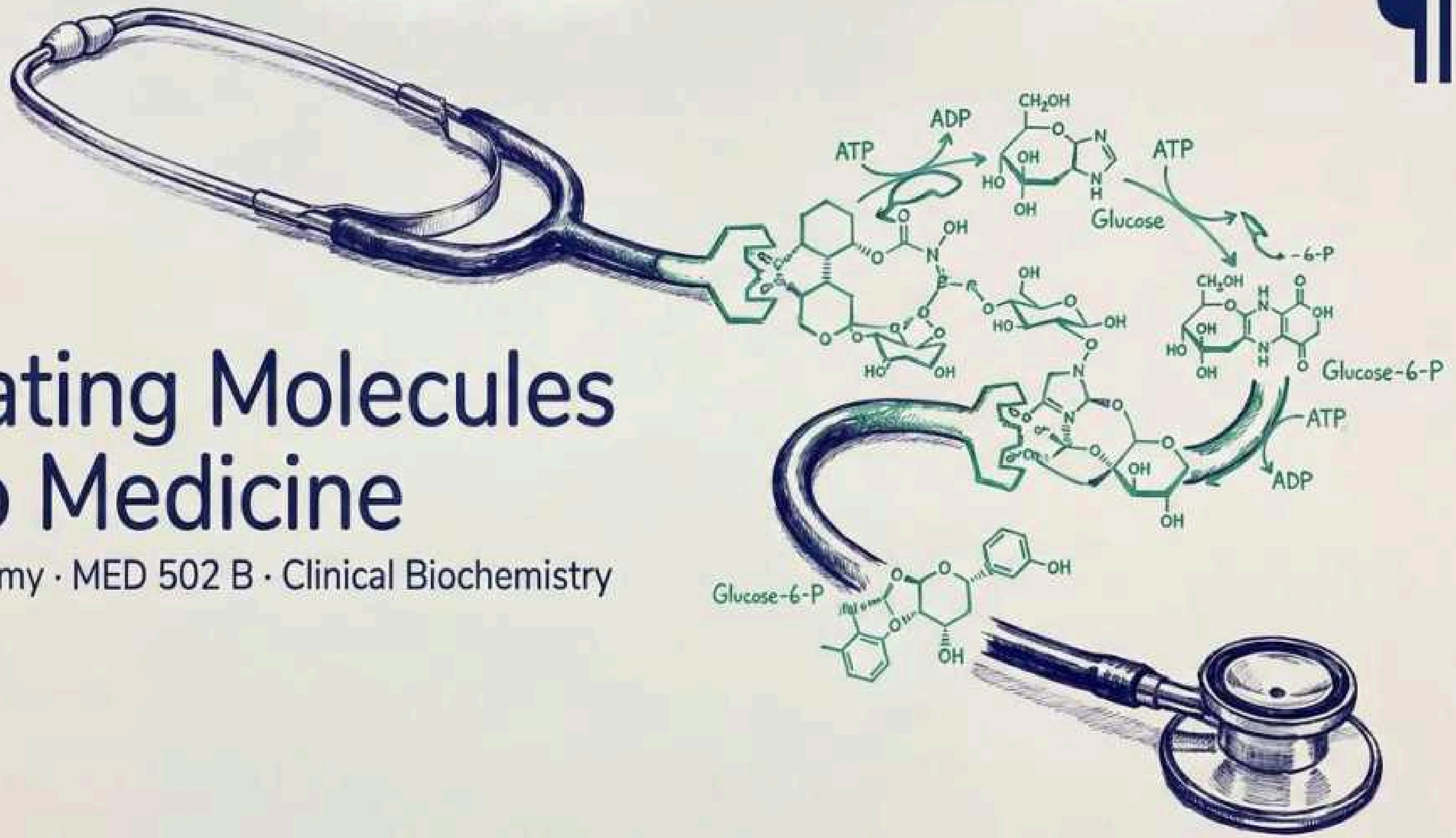


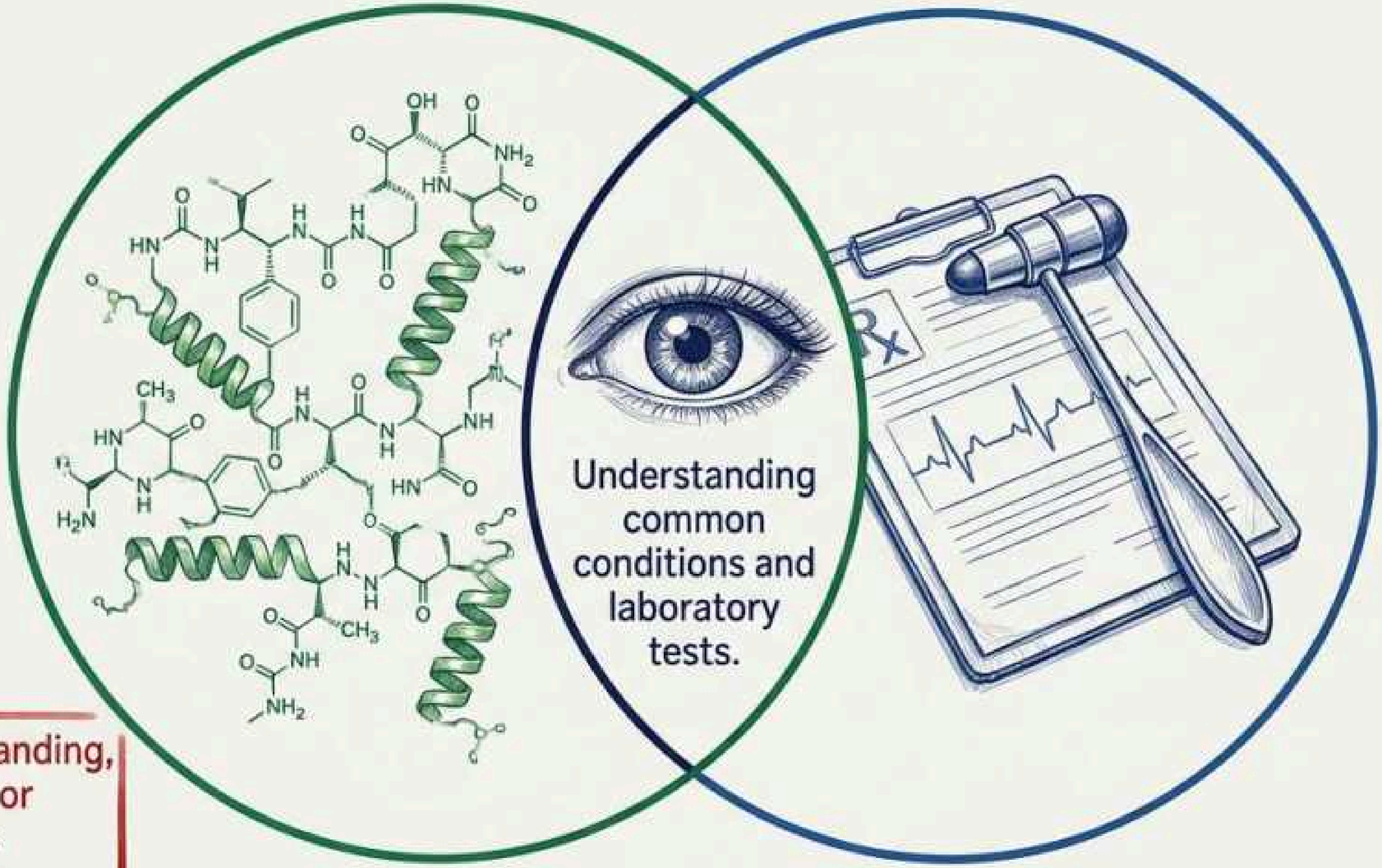
Translating Molecules to Medicine

Anderson Academy · MED 502 B · Clinical Biochemistry

Diabetes, Cholesterol, Vitamins, and the Laboratory

Biochemistry at Work in Everyday Medicine

¶ 6.1

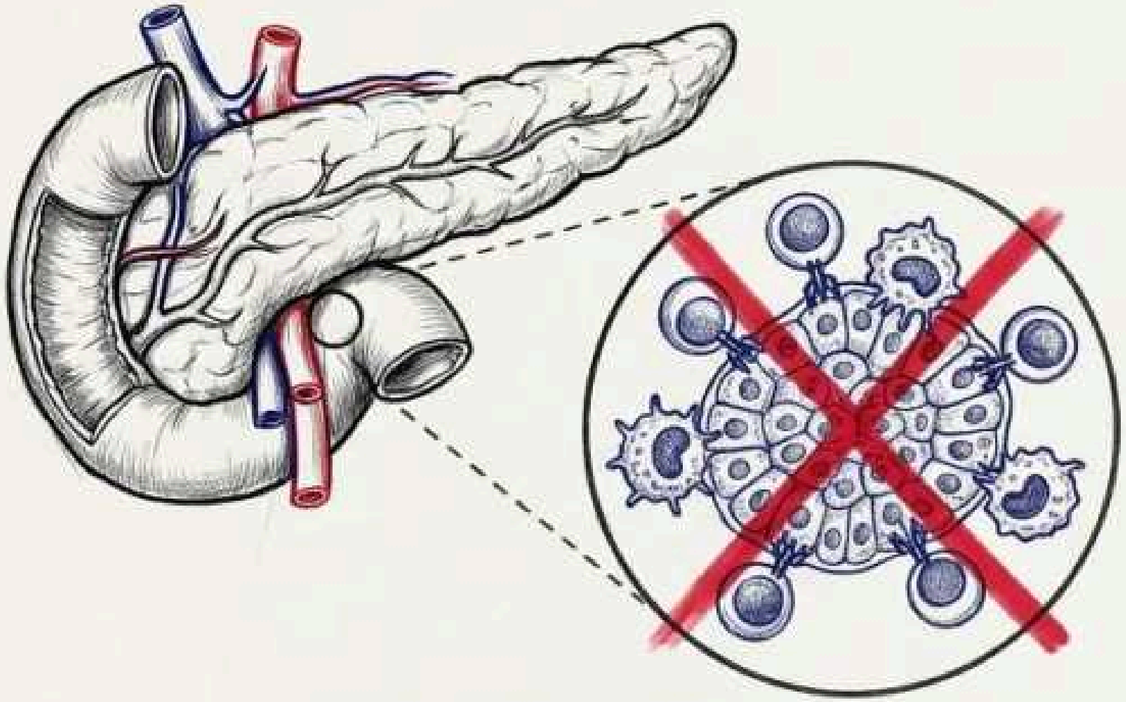


The aim is understanding, not self-diagnosis or treatment. Always consult a physician regarding your health.

Diabetes Mellitus Exhibits Disordered Fuel Metabolism

In all forms, blood glucose is too high because insulin is either missing or ineffective.

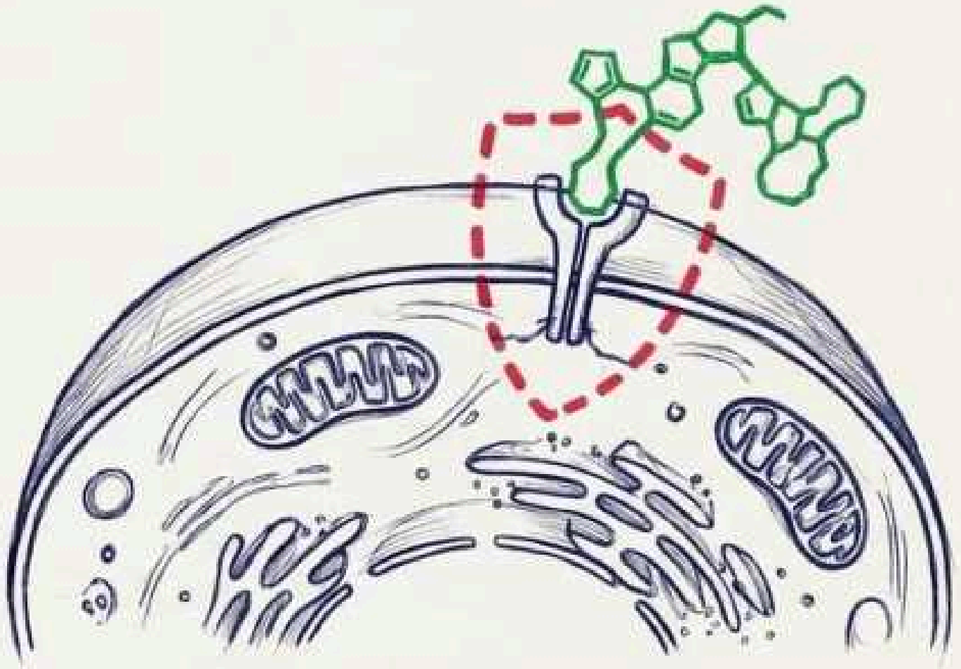
Type 1 Diabetes



Insulin = 0

Immune system destroys insulin-making cells; requires lifelong insulin treatment.

Type 2 Diabetes



Insulin Resistance > Pancreatic Output

Cells respond poorly to insulin; pancreas eventually cannot keep up.

The Cascading Consequences of Ineffective Insulin

Lack of Effective Insulin

Type 1 only

Glucose → ✕ Muscle/Fat

Liver manufactures glucose (as if fasting)

Unrestrained Fat Breakdown

High Blood Glucose

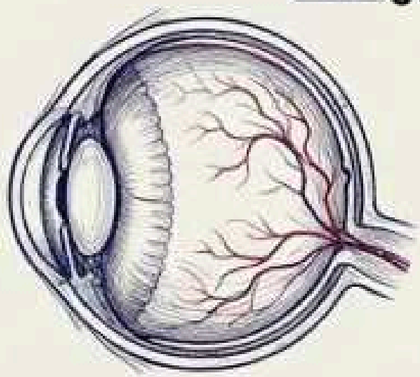
Ketoacidosis

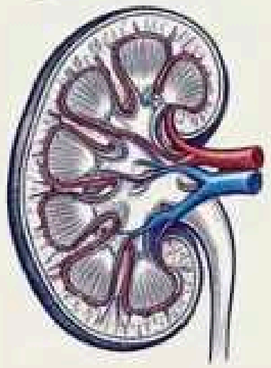
Spills into Urine

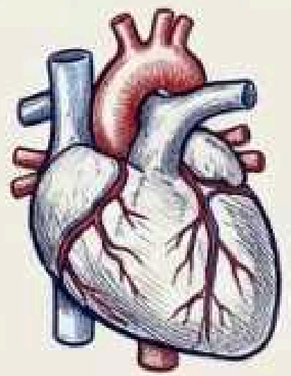
Takes Water (Osmotic Diuresis)

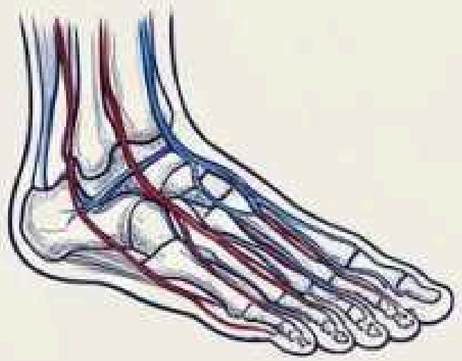
Thirst & Frequent Urination

Long-term High Glucose Damages Blood Vessels & Nerves



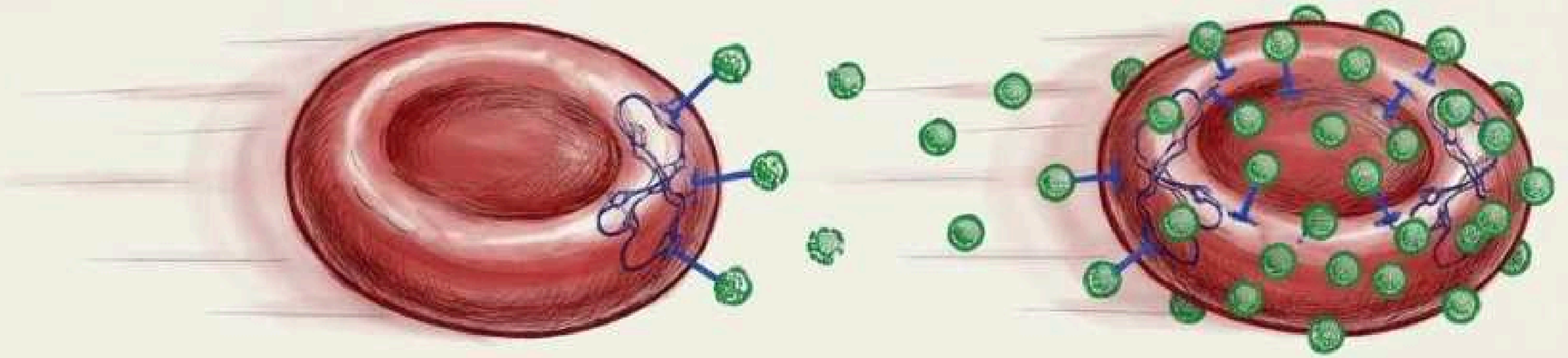






HbA1c Provides a Three-Month Window into Blood Glucose

¶ 6.4



Day 0 — Day 90

$$HbA_{1c}\,\% \approx \text{Average } [\text{Glucose}]_{90\ \text{days}}$$

Single glucose readings change hour by hour.

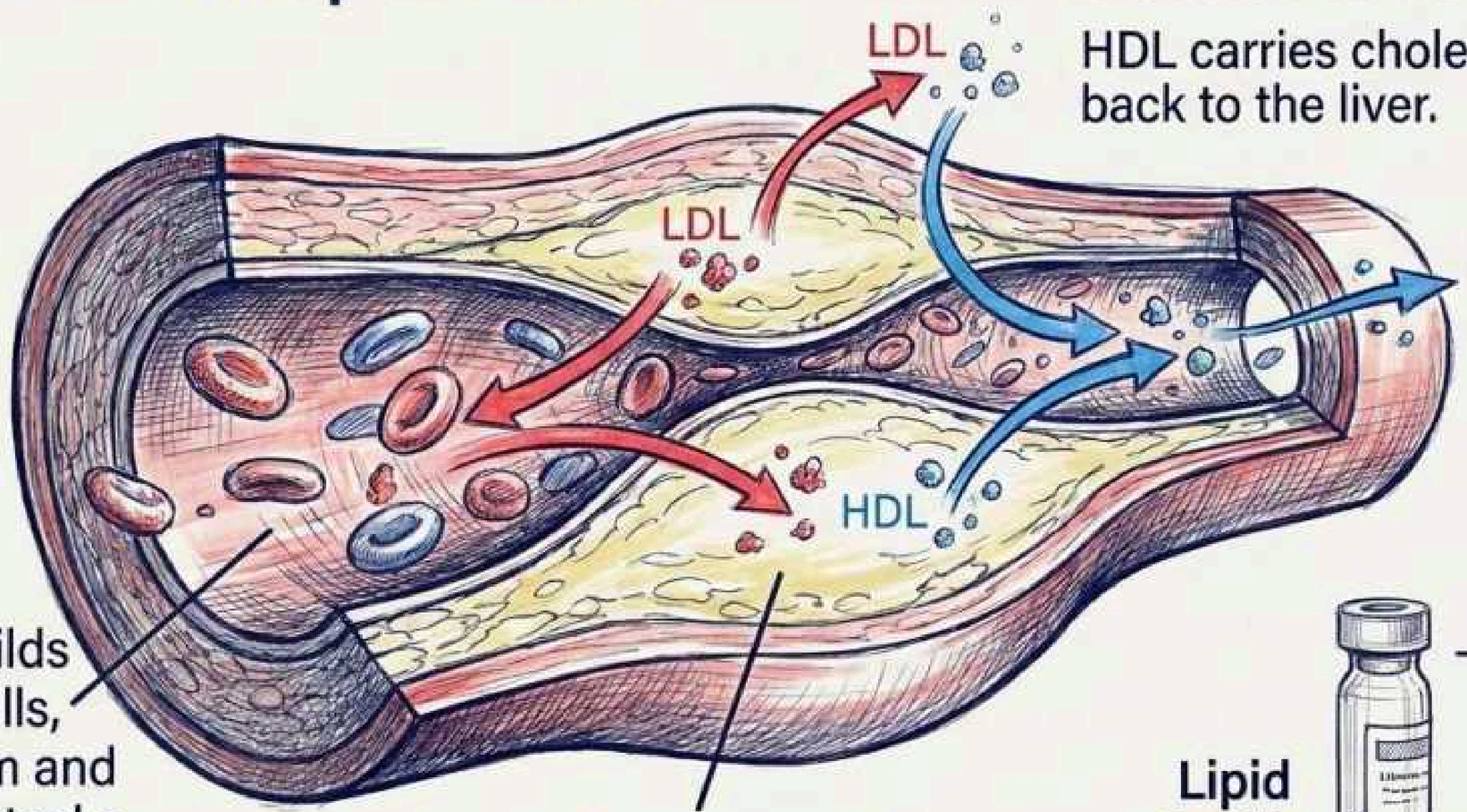
Red blood cells live approximately three months. HbA1c measures the share of haemoglobin that has glucose attached, revealing the 2-3 month average.

Atherosclerosis is a Lipoprotein Transport Error

¶ 6.5

LDL carries cholesterol to tissues;

HDL carries cholesterol back to the liver.



Cholesterol builds up in artery walls, narrowing them and risking heart attacks and strokes.

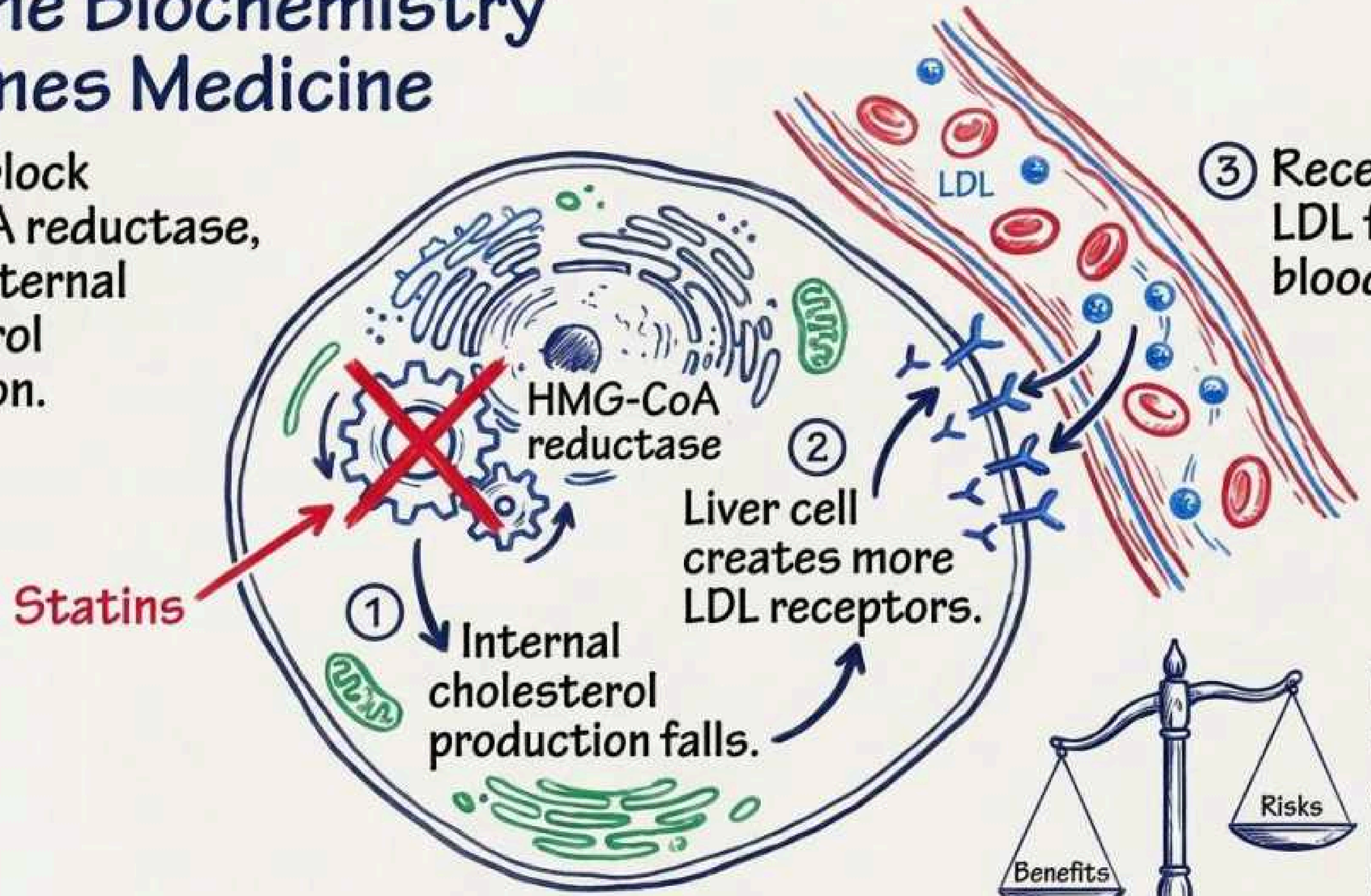
Atherosclerosis

Lipid Profile

Measures lipoproteins and triglycerides.

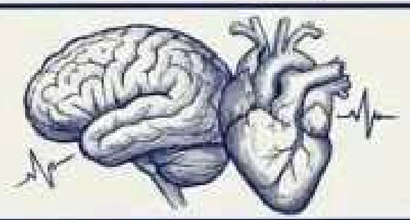
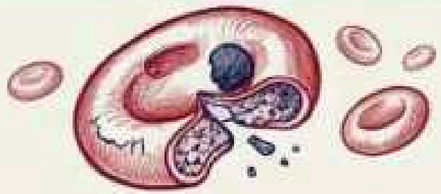
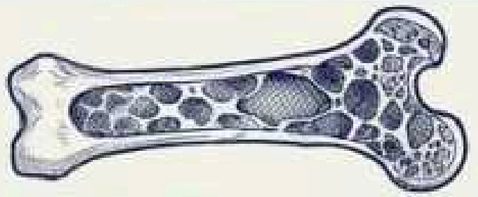
Enzyme Biochemistry Becomes Medicine

Statins block HMG-CoA reductase, halting internal cholesterol production.



Prescribing requires a doctor and patient to weigh benefits and risks.

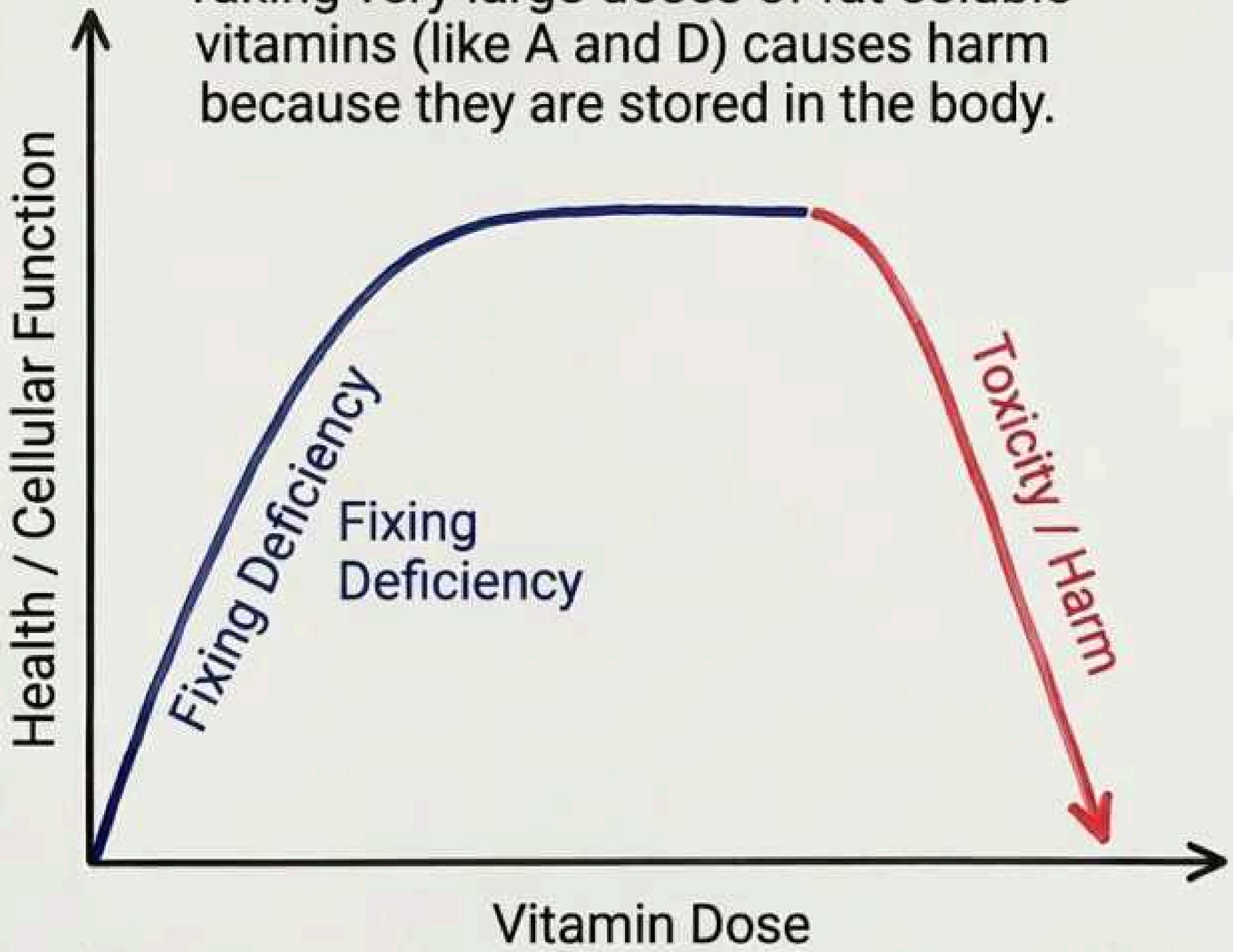
Missing Vitamins Stop Crucial Enzymes from Working

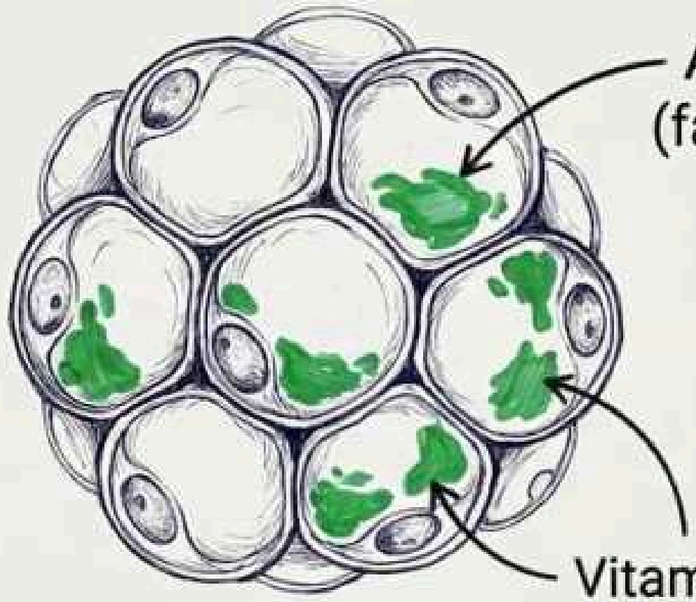
Vitamins as Coenzymes		
Vitamin	Biochemical Role	Clinical Consequence
Thiamine (B1)	Impaired energy metabolism	
Vitamin C	Impaired collagen synthesis	
Vitamin B12 / Folate	Disrupted DNA synthesis	
Vitamin D	Impaired calcium handling	

The Body Requires Precision, Not Maximum Volume

¶ 6.8

Taking very large doses of fat-soluble vitamins (like A and D) causes harm because they are stored in the body.



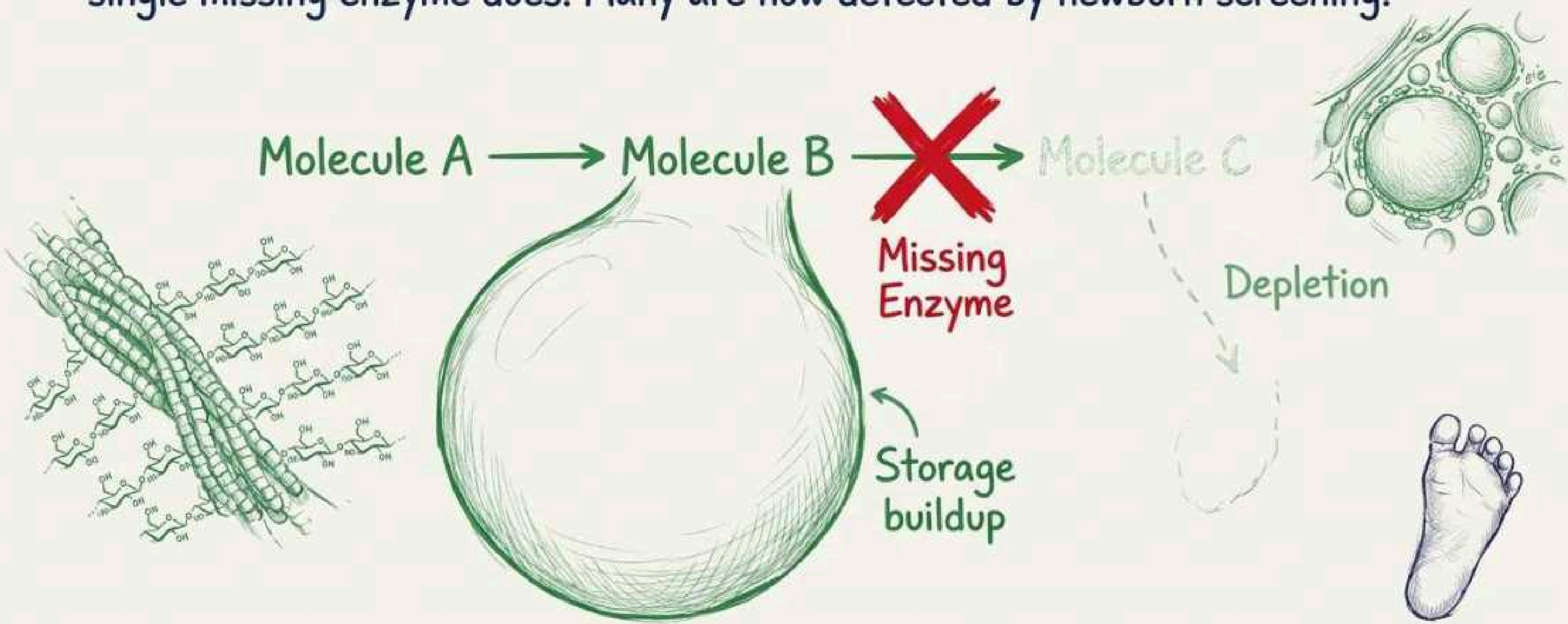


Biochemistry's simple lesson: more is *not* automatically better. Supplement advice belongs with a doctor or dietitian.

Inherited Metabolic Diseases Act as Natural Experiments

¶ 6.9

Individually rare but collectively common, diseases affecting **glycogen storage**, **fat** breakdown, or complex molecules reveal exactly what a single missing enzyme does. Many are now detected by newborn screening.



The Clinical Laboratory is a Window into Biochemistry

¶ 6.10

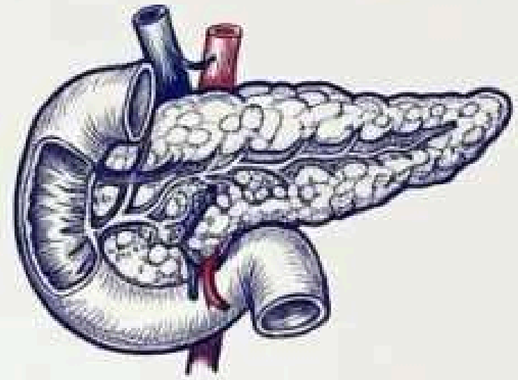
Comprehensive Metabolic Panel

- Glucose
- Urea, Creatinine
- Electrolytes (Na, K)
- Liver Enzymes
- Proteins
- Lipids

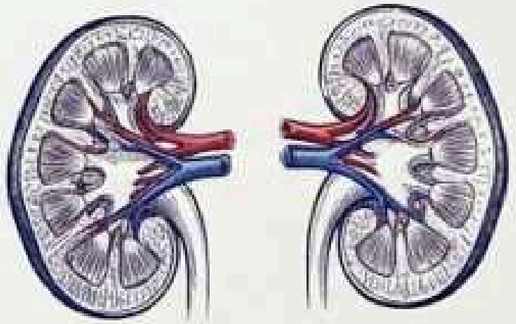
Reference Range

Slightly outside range is not necessarily abnormal; inside range does not rule out disease.

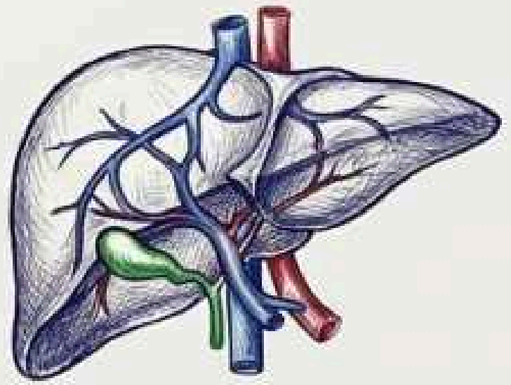
Balance of fuels →



Work of the kidneys →



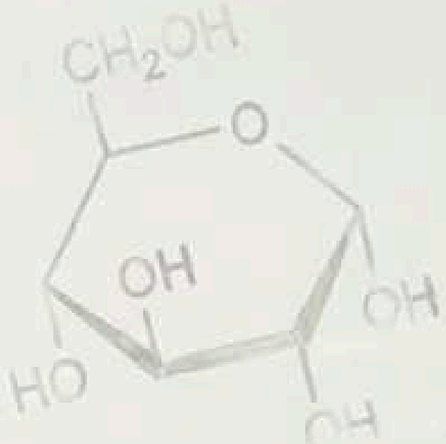
Health of the liver →

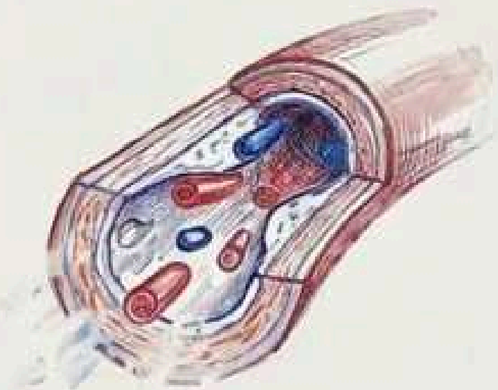


Interpreting these results requires a doctor's training and the whole picture of the patient.

The Final Inquiry

¶ 6.11



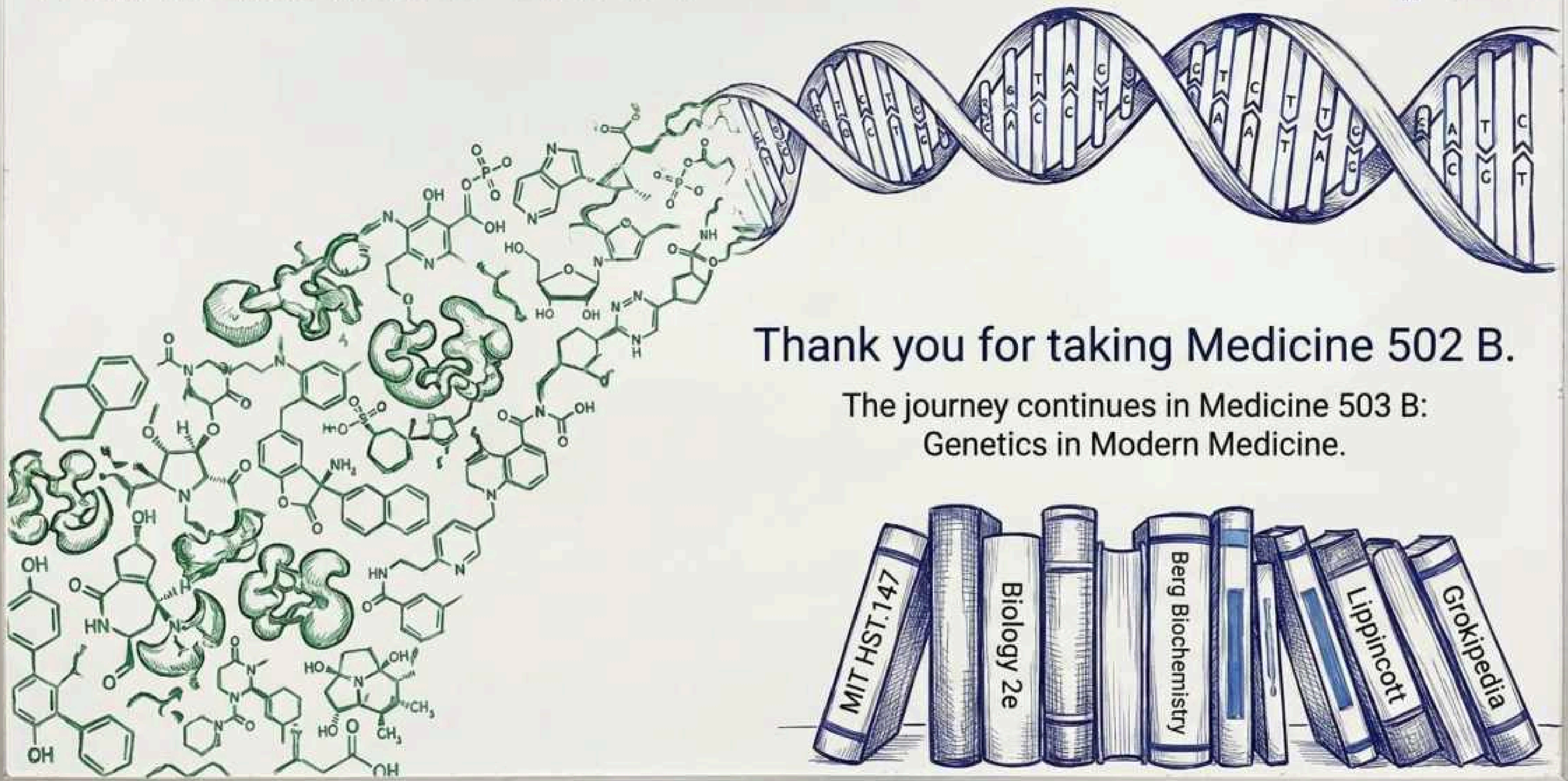


Choose one common blood test from this lecture and explain, using the biochemistry of the course, what it measures and why that tells a doctor something useful.

Then check your answer against the Course Book.

From Metabolism to Genetics

¶ 6.12



Thank you for taking Medicine 502 B.

The journey continues in Medicine 503 B:
Genetics in Modern Medicine.