

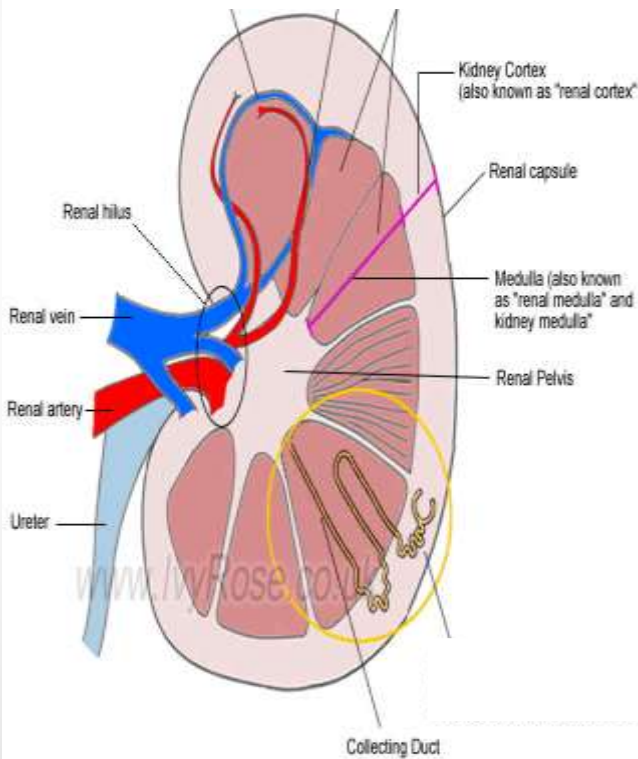
# Homeostasis

- **Carbon dioxide** must be removed because when it **dissolves** it makes an acidic solution which can affect **enzymes** working
- Carbon dioxide is removed by **diffusing** into the **blood stream** and being exhaled from the **lungs**
- **Urea** is made in the liver from the break down of amino acids and is **poisonous** if levels build up
- It is **filtered** out of the blood by the **kidneys** and passed out in our **urine...yum!**
- **Water** and **ions** enter your body when you drink
- They must be carefully monitored so you don't **damage your cells**
- Water is lost through **breathing, sweating** and in **urine**.
- Ions are lost through **sweat** and in **urine**
- If these concentrations change, water will move in and out through **osmosis** to correct the balance
- Too much of this could damage your cells
- **Body temperature** must also be controlled, along with **sugar levels** in your **blood**.

# The kidney

## The function of the kidney

- The kidneys are extremely important for homeostasis
- They remove waste products from the blood
- They also regulate the water balance in your body



# How does the kidney filter the blood?

1. The kidney filters the blood
2. It uses diffusion, as sugar, amino acids, mineral ions, urea and water all have a higher concentration in the blood so move along the concentration gradient and into the kidneys
3. This leaves behind large molecules (that don't fit through the membrane) like blood cells
4. It then reabsorbs the sugar back into the blood by active transport
5. It also can reabsorb water, depending on how much the body requires - selective reabsorption

Some urea will move back into the blood by diffusion, along a concentration gradient.

# Dialysis

1. Give 3 examples of things that can cause kidney damage or failure.

Infections, genetic problems, accidents.

2. What is kidney dialysis?

It cleans the blood, removing it from the body and passing it between partially permeable membranes.

3. How is kidney dialysis used to treat kidney failure?

It removes urea and mineral ions that become built up in the blood. You also don't want to lose useful substances e.g. glucose.

The dialysis fluid carefully controls the correct concentration of glucose and useful mineral ions so there is no net movement of glucose and the ions from the blood. Urea and non useful excess ions move out of the blood along a concentration gradient.

4. How long does kidney dialysis take and how often do people use it?

8 hours, several times a week for a few hours

5. What would happen if kidney dialysis wasn't used?

Urea and excess mineral ions would build up which can be poisonous

6. How does diffusion allow dialysis to happen?

The dialysis fluid is very carefully controlled. It contains the correct amount of useful ions and glucose so that these don't move out of the blood, as the concentration is the same in the fluid as the blood. Therefore none is lost.

Where the dialysis fluid contains no urea, creating a steep concentration gradient so it leaves the blood.

## 7. What are the advantages of dialysis?

They can filter the blood instead of the kidneys, allowing people to survive for a lot longer. This buys time for kidney transplants. Kidney failure used to mean certain death, it no longer does because of dialysis.

In 1964 some home dialysis machines were made available.

## 8. What are the disadvantages of dialysis?

The machines are very big and expensive and therefore are usually found in hospitals. People have to spend a very long time wired up to these.

You have to follow a very carefully controlled diet to help keep the blood chemistry as stable as possible. However over the years the blood chemistry can be very difficult to control.

- (ii) *In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.*

The person with the kidney disease could be treated either by using a dialysis machine or by a kidney transplant operation.

Compare the **advantages** and **disadvantages** of these two methods of treatment.

Use your knowledge and understanding of the two methods in your answer.

*advantages of transplant over dialysis*

- no build-up of toxins / keeps blood concentration constant
- prevent high blood pressure
- don't need restricted diet / restricted fluid intake or time wasted on dialysis
- blood clots may result from dialysis
- infection may result from dialysis
- with dialysis, blood may not clot properly due to anti-clotting drugs
- cost issues (ie transplant cheaper)

*disadvantages of transplant over dialysis*

- rejection / problem finding tissue match
- use of immuno-suppressant drugs leading to other infections
- dangers during operation



# Controlling body temp.

- Exercise, fevers caused by disease and external temperature can affect body temperature
- Control of body temp. is through the thermoregulatory centre in your brain. This monitors the blood temp. flowing through the brain.
- If you heat up your blood vessels dilate, causing skin to flush and lose more energy by radiation.
- The rate of sweating increases, cooling the body down through evaporation.
- To reduce energy loss blood vessels constrict, reducing energy loss via radiation.
- Less sweat is produced and you may shiver, making your muscles respire, releasing more heat energy.



# Temperature issues

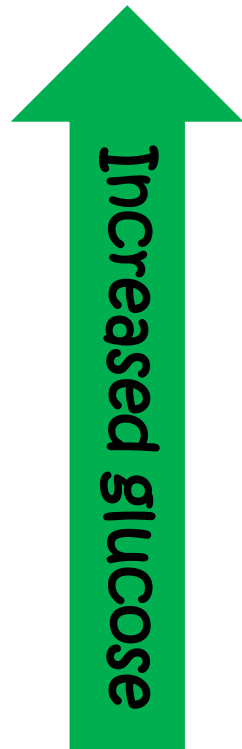
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# Blood glucose

Insulin  
released

Glucose  
moved into  
cells for  
respiration

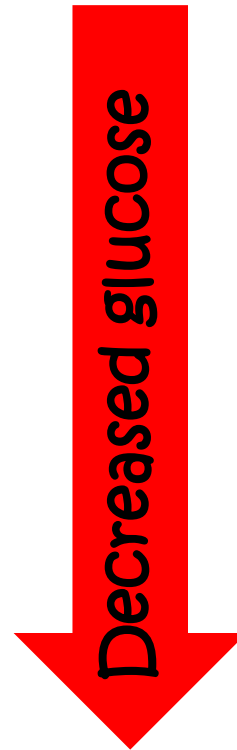
Excess  
glucose  
stored as  
glycogen




Glucagon  
released

Glycogen  
from liver  
broken down  
into glucose

Glucose used  
for  
respiration



# Diabetes



HbA <sub>1c</sub> test score	MEAN BLOOD GLUCOSE mg/dL	mmol/L
14.0	380	21.1
13.0	350	19.3
12.0	318	17.4
11.0	280	15.6
10.0	250	13.7
9.0	215	11.9
8.0	180	10.0
7.0	150	8.2
6.0	115	6.3
5.0	80	4.7
4.0	50	2.6

A vertical color scale on the left of the table indicates the quality of the HbA<sub>1c</sub> score. It ranges from a red 'sad face' at the top (14.0) to a green 'happy face' at the bottom (4.0). The scale is labeled 'excellent' at the bottom and 'action suggested' at the top.

- If your pancreas doesn't make enough/any insulin, your blood sugar concentration is not controlled
- Your blood sugar levels will become very high after you eat, causing your kidneys to excrete glucose and making you produce lots of urine. This makes you thirsty all the time.
- Glucose can't travel into the cells, so you lack energy and feel tired.
- You break down protein and fat to use for energy instead

# Treating diabetes

- In 1920s Banting and Best made some dogs diabetic by removing their pancreas
- They gave them extracts of other dogs' pancreases (which contained insulin) and showed that it could keep the dogs alive
- Banting and Best realised extracts of animals pancreases could keep people with diabetes alive
  
- For years, insulin from pigs and cows was used to treat people
- However this insulin wasn't identical to peoples'
- It also depended on how many animals were being killed for meat, sometimes there wasn't enough insulin to go around
- We now use genetic engineering to create natural human insulin

