Lesson Description

In this lesson we:

- Define homeostasis
- State that the conditions within cells depends on the conditions within the internal environment (the tissue fluid)
- List the factors/conditions within tissue fluid that should be kept constant, within narrow limits
- Describe the control of the levels of the following through negative feedback:
  - Glucose
  - Carbon dioxide
  - Water
  - Salts
- Identify the different parts of the skin involved in thermoregulation
- Describe the role of each of the following in the process of thermoregulation:
  - Sweating
  - Vasodilation
  - Vasoconstriction

Summary

It's all a balancing act!
The Internal Environment

What has to be controlled?

- Carbon dioxide
- Oxygen
- Urea
- Salts
- Glucose
- Water
- Temperature
- pH

Negative Feedback Mechanism

Normal CO₂ and blood pH → High blood CO₂ levels → Disease raises blood CO₂ levels

Blood CO₂ levels fall; pH of the blood returns to normal → Drop in blood pH → Low pH detected by chemoreceptors → Medulla stimulates increased rate and depth of breathing → Increased rate of removal of CO₂ from the body → Normal CO₂ and blood pH
Thermoregulation

Skin Diagram

- Sweat gland
- Blood vessels
- Seb duct
- Epidermis
- Dermis

Control Center
(thermoregulatory center in brain)

Stimulus
Body temperature rises

Response
Body temperature rises; stimulus ends

Stimulus
Body temperature falls

Response
Evaporation of sweat
Body temperature falls; stimulus ends

Effectors
Sweat glands

Effectors
Skeletal muscles

Receptors
Temperature-sensitive cells in skin and brain

Information sent along the afferent pathway to control center

Information sent along the efferent pathway to effectors

IMBALANCE

BALANCE
Thermoreceptors → Increased sweating vasodilation

Increase in body temperature → Normal body temperature (37°C) → Thermoreceptors
Decrease in body temperature → Normal body temperature (37°C) → Thermoreceptors

Normal body temperature (37°C) → No change → Normal body temperature (37°C)

Thermoreceptors → Shivering, vasoconstriction

Increase in body temperature → Normal body temperature (37°C) → Thermoreceptors
Decrease in body temperature → Normal body temperature (37°C) → Thermoreceptors

KEEP CALM AND MAINTAIN HOMEOSTASIS
Additional Information

Drugs that affect water balance

- **Alcohol**
  Alcohol causes the kidneys to produce a greater volume of more dilute urine. This can lead to dehydration.

- **Ecstasy**
  Ecstasy causes the kidneys to produce a smaller volume of less dilute urine. This can result in the body having too much water.

  - **How alcohol and ecstasy affect ADH**
    Alcohol suppresses ADH production. This causes the kidneys to produce more dilute urine. It can lead to dehydration.
    Ecstasy increases ADH production. This causes the kidneys to reabsorb water. It can result in the body having too much water.

**Test Yourself**

Select the most correct answer from the options given. Write down only the correct letter

**Question 1**

The process of keeping the body at a constant temperature.

A  Osmoregulation  
B  Glucoregulation  
C  Thermoregulation

**Question 2**

Human enzymes work best at body temperature which is …

A  0°C  
B  24°C  
C  30°C  
D  37°C

**Question 3**

Which organs are important in regulating body temperature?

1. Skin  
2. Kidney  
3. Liver  
4. Pancreas

A  1 only  
B  1 and 2  
C  3 and 4  
D  1 and 3
Question 4
The islets of Langerhans are found in the …
A  Pancreas
B  Kidneys
C  Liver
D  Thyroid gland

Question 5
The target of the hormone ADH is:
A  Kidney
B  Heart
C  Pancreas
D  Liver

Question 6
Indicate whether each of the statements in COLUMN I applies to A only, B only, both A and B or none of the items in COLUMN II. Write A only, B only, both A and B or none next to the question number.

<table>
<thead>
<tr>
<th>COLUMN I</th>
<th>COLUMN II</th>
</tr>
</thead>
</table>
| 1 Carbon dioxide levels                | A: Medulla oblongata  
|                                        | B: Cerebellum     |
| 2 Vasodilation                         | A: 10°C          
|                                        | B: 40°C           |
| 3 Increases the loss of heat in mammals| A: Sweating    
|                                        | B: Shivering      |
| 4 Normal human body temperature        | A: 36°C          
|                                        | B: 46°C           |

Question 7
Study the table below that shows the volume of urine produced by six different people on a hot day and on a cold day and answer the questions that follow.

<table>
<thead>
<tr>
<th>Person</th>
<th>Volume of urine produced in cm³</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hot day</td>
</tr>
<tr>
<td>1</td>
<td>430</td>
</tr>
<tr>
<td>2</td>
<td>350</td>
</tr>
<tr>
<td>3</td>
<td>270</td>
</tr>
<tr>
<td>4</td>
<td>560</td>
</tr>
<tr>
<td>5</td>
<td>400</td>
</tr>
<tr>
<td>6</td>
<td>390</td>
</tr>
<tr>
<td>Mean</td>
<td></td>
</tr>
</tbody>
</table>

7.1 Calculate the mean volume of urine in cm³ produced on the hot day.
Show ALL workings.  (3)

7.2 What can you deduce from the difference between the mean volume of urine produced on the hot day and the mean volume of urine produced on the cold day?  (2)

7.3 Explain why, on a hot day, less water is lost from the body as urine.  (2)
Improve your Skills

Question 1

1.1 Define the term Homeostasis. (2)
1.2 Name the internal environment of humans. (1)
1.3 List FOUR factors that must be kept constant in the internal environment of humans. (4)
1.4 Explain how the concentration of carbon dioxide is regulated in the body of a person who is doing a lot of work for his team while playing soccer. (7)

Question 2

A normal blood glucose level is 1,0 mg/cm\(^3\) and a normal insulin level is 0,5 mg/cm\(^3\). A group of people with normal levels of blood glucose and blood insulin were tested over a period of 5 hours. The average values were calculated and are indicated in the graph below. Study the graph and answer the questions that follow.

2.1 What is the glucose level at 3 hours after the start of the investigation?
2.2 Describe the relationship between insulin and blood glucose by referring to the graphs.
2.3 Explain how the blood glucose level increases between 2 and 3 hours after the investigation starts, even though no food is eaten.
2.4 Name the organ in the body which produces insulin.
Question 3

Study the diagram below and answer the questions that follow.

3.1 Label layer C and part B. 
3.2 Describe the changes in the above organ when the outside temperature is 7°C 

Links

Learn Xtra Live 2013:

Osmoregulation:
- [http://www.bbc.co.uk/schools/gcsebitesize/science/21c/keeping_healthy/healthy_balancerev5.shtml](http://www.bbc.co.uk/schools/gcsebitesize/science/21c/keeping_healthy/healthy_balancerev5.shtml)
- [https://www.youtube.com/watch?v=vB7tSHqR1eY](https://www.youtube.com/watch?v=vB7tSHqR1eY)

Diabetes causes, symptoms, management:
- [https://www.youtube.com/watch?v=sTgBvJsHcCk](https://www.youtube.com/watch?v=sTgBvJsHcCk)