ACTIVITY SOLUTIONS

Stimulus–response feedback model

1. The first five arrows represent information that is being passed from one place to another. The broken line arrow is representing negative feedback, that is the stimulus is being reversed by the response.
2. Eye, ear, skin, brain
3. Increased temperature, decreased blood glucose
4. Liver, kidneys, sweat glands

Regulation of body temperature

1. Convection
2. Conduction
3. Radiation
4. Evaporation

Increase external temperature

Match the columns

1.	Stimulus	b
2.	Receptor	c
3.	Modulator	e
4.	Effectors	a
5.	Response	d
6.	Feedback	f

Regulation of Body Fluids

1. Intracellular fluid is found within the cells (cytosol). Extracellular or interstitial fluid includes blood plasma and the fluid between cells including cerebrospinal fluid, synovial fluid, fluids in the eyes and ears, around the heart and in the alimentary canal and kidney filtrate.
2. Water and dissolved substances such as gases, nutrients, ions, proteins, minerals, vitamins.
3. Body fluids are gained in the foods we eat, drinks we drink and from metabolic reactions (cellular respiration). Body fluids are lost via the lungs (exhaled air is moist), the skin (sweat), kidneys (urine) and alimentary canal (faeces)
4. Intracellular fluid found within the cell; Extracellular fluid is fluid found outside the cell; plasma is the fluid part of the blood; interstitial/intercellular/tissue fluid is the fluid which bathes the cells.
5. The smaller the molecules the easier the movement – larger molecules do not move as readily.

6. Small molecules move by diffusion from a region of high concentration to a region of low concentration. Water molecules move by osmosis.
7. The lymphatic system assists in draining excess fluid from the cells and tissues.

Decreased Osmotic Pressure

1. Stimulus: A decrease in osmotic pressure (water concentration in plasma increases)
2. Receptor: Osmoreceptors in the hypothalamus
3. Modulator: Hypothalamus send message to inhibit release of ADH from posterior lobe of the pituitary gland. Adrenal cortex reduces secretion of aldosterone.
4. Effectors: Kidney tubules become less permeable to water. Kidney tubules decrease reabsorption of sodium ions into the blood.
5. Response: Decreased reabsorption of water into plasma causes an increase in osmotic pressure. Increase in urination to expel water.
6. Feedback: Increase in osmotic pressure

Blood Glucose Regulation

Provide the correct term for each definition	
Term	**Definition**
1. Gluconeogenesis	The making of new glucose molecules from substances such as proteins and lipids
2. Glycogenesis	Formation of glycogen from carbohydrates, mainly glucose
3. Lipogenesis	The conversion of glucose to fat
4. Glycogenolysis	The breakdown of glycogen to glucose
5. Lipolysis	The breakdown of fat into glucose

High Blood Glucose

1. Stimulus d
2. Receptor e
3. Modulator b
4. Effectors a
5. Response c
6. Feedback f

Regulation of Gas Concentrations

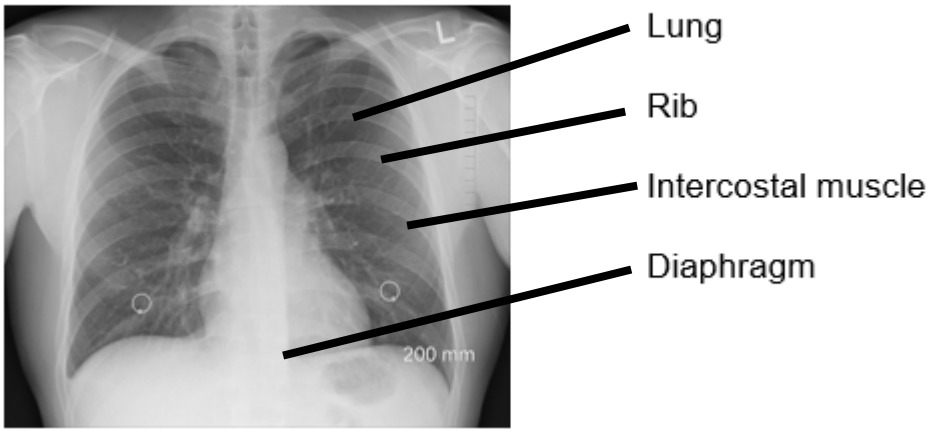

Image by oracast from Pixabay

Control of Breathing

1. Stimulus b
2. Receptor d
3. Modulator a
4. Effectors e
5. Response c
6. Feedback f

Feedback loops

1. Blood sugar levels
2. Gas concentration
3. Thermoregulation, Body Fluid concentrations

The diabetes dilemma

1. False. The pancreas can produce some but not sufficient amounts of insulin in type 2.
2. True. Type 1 is usually seen in children or very young adults.
3. False. In type 1 the pancreas has often ceased production of insulin due to the body's immune cells attacking the beta cells. In type 2 the body is still producing insulin, but not in sufficient amounts
4. True. Even though in this form of Diabetes insulin is still being produced, it is usually due to the receptor cells not functioning as efficiently.
5. True. This condition is caused by the body's immune system attacking the beta cells of the pancreas, rendering them completely unproductive.
6. False. Type 2 develops slowly in later life and is sometimes diagnosed as 'old age' or 'overwork'.
7. True. This is a serious risk factor and is often one of the first areas a patient must attend to if they are to manage the disease effectively.
8. False. This type of diabetes develops in the later months of pregnancy but normally disappears once the child is born.
9. False. It is not possible to take insulin as a tablet as it is a protein and would be broken down by the digestive enzymes in the stomach. It has to be administered by injection or a specifically designed injection pump.
10. True. As this type of Diabetes develops in early life, the name 'juvenile' is often used.

Hormonal conditions – What goes wrong and how to fix them

Disruption condition	Cause	Homeostatic mechanism involved	Which parts of feedback model are affected? (eg: receptor/ modulator/effector)	Impact in body	Symptoms
Diabetes Type I	**beta cells not producing enough insulin or none at all**	**blood glucose regulation**	**receptor, modulator – beta cells in pancreas**	**lack of insulin** **results in glucose not taken up by cells/liver/muscles** **insufficient glucose in cells for respiration to proceed** **glucose remains in circulating blood**	**Short-term** **tiredness, hunger, increase in osmotic pressure leads to thirst.** **Long-term** **damage to the large blood vessels of the heart, brain and legs** **damage to the small blood vessels, causing damage in to the eyes, kidneys, feet and nerves – can lead to blindness, kidney failure, amputation of limbs**
Diabetes Type 2	**body cells do not respond to insulin**	**blood glucose regulation**	**effector – body cells**	**results in glucose not taken up by cells/liver/muscles** **insufficient glucose in cells for respiration to proceed** **glucose remains in circulating blood**	**Short-term** **may be no symptoms** **Long-term** **damage to the large blood vessels of the heart, brain and legs** **damage to the small blood vessels, causing damage in to the eyes, kidneys, feet and nerves – can lead to blindness, kidney failure, amputation of limbs**
Hyperthyroidism	**over-secretion of thyroxine**	**metabolic rate**	**effector – thyroid gland**	**elevated levels of thyroxine causes metabolic rate to rise**	**weight loss** **increased heart rate** **palpitations** **nervousness** **trembling hands** **insomnia**

Hypothyroidism	**under-secretion of thyroxine**	**metabolic rate**	**effector – thyroid gland**	**decreased levels of thyroxine causes reduced metabolic rate**	**weight gain** **tiredess** **dry skin** **intolerance to cold** **slow heart rate**

Treatments for hormonal conditions

	Treatments for hormonal conditions
Diabetes	Type 1: Regular injections of insulin. Cannot be swallowed as insulin is digested in the alimentary canal. Can be administered by a pump also. This is not a cure and is the only way to manage the condition. Type 2: The only treatment is a management program that keeps the levels of insulin within normal limits. This includes a moderate diet, regular physical activity, maintaining a healthy weight, monitoring of blood glucose and possible use of medication if the levels are not controllable any other way.
Hypothyroidism	Drug treatment is used to replace the thyroxine not being produced from the thyroid gland. Also iodine can be the reason for the malfunction of the gland so supplements may treat the condition.
Hyperthyroidism	Drug treatment is used to block the thyroid gland's use of iodine or by surgery to remove some or all of the gland. Alternatively, radioactive iodine is administered and taken up by the cells of the thyroid. The result is to kill off some of the cells to reduce the symptoms.

PAST EXAM QUESTION SOLUTIONS AND MARKING KEY

Answers for Questions 32,35 and 38 taken from the 2018 ATAR Human Biology ratified marking key

Source: School Curriculum and Standards Authority, Human Biology 2018 ATAR Examination
https://senior-secondary.scsa.wa.edu.au/further-resources/past-atar-course-exams/human-biology-past-atar-course-exams

Question 32 **(11 marks)**

(a) Complete the feedback loop by writing the appropriate word/s in the spaces provided. (5 marks)

Description	Marks
Receptors – skin	1
Modulator – hypothalamus	1
Effectors – skeletal/voluntary/striated muscles	1
Response – vasoconstriction – (increase) heat production	1 1
Total	**5**

(b) The people who found Jai in the snow gave him first aid. Identify **two** behavioural strategies the first aiders could have employed to help his body recover from hypothermia. (2 marks)

Description	Marks
Any two of the following	
Remove person from cold environment/place in warm environment/hugging	1–2
Remove wet clothes	
Cover in dry warm clothes/layers/blankets	
Provide warm liquids/foods	
Total	**2**

Question 35 **(12 marks)**

(a) (i) In the diagram above, what would structure A be? (1 mark)

Description	Marks
Pancreas/islets/alpha cells	1
Total	**1**

(ii) In this scenario, structure A releases a hormone that acts on the liver. What name is given to this hormone? (1 mark)

Description	Marks
Glucagon	1
Total	**1**

(iii) Adrenalin acts on many structures to help increase blood sugar levels. What process is occurring at B that would contribute to the raising of blood sugar levels? (1 mark)

Description	Marks
Breakdown of fats/lipolysis/break down of amino acids/gluconeogenesis	1
Total	**1**

(iv) What other endocrine gland not shown in the diagram above could possibly be involved in maintaining blood sugar levels? (1 mark)

Description	Marks
Thyroid/adrenal cortex	1
Total	**1**

(b) To help lower blood sugar levels, a series of processes occurs in various effectors. Define each of the following terms and name the structures in which each process occurs. (4 marks)

Description			Marks
One mark for definition and one mark for structure			
Process	**Definition**	**Structure/s**	
Glycogenesis	Converts glucose into glycogen	Liver/muscle cells	1–2
Lipogenesis	Glucose converted to fat/fatty acid synthesis from glucose	Fat cells/adipose tissue	1–2
		Total	**4**

(c) Explain why a person with diabetes would feel the effects of high blood sugar, such as tiredness and excessive thirst. (4 marks)

Description	Marks
Any four of the following	
Lack of insulin in blood/lack of effective insulin	1–4
Cells are starved of glucose	
Cells cannot respire to produce energy/tiredness	
High glucose level increases osmotic pressure	
Hypothalamus triggers a thirst reflex	
Total	**4**

Question 38 **(12 marks)**

(a) Suggest a hypothesis that this experiment was designed to test. (1 mark)

Description	Marks
Statement linking independent and dependent variable	1
Total	1
Sample hypothesis: Use of the new asthma bronchodilator will increase blood oxygen concentration.	

(b) Name the independent and dependent variables (2 marks)

Description	Marks
Independent – asthma bronchodilator	1
Dependent – blood oxygen concentration	1
Total	2

(c) Why was a placebo used for group 2 participants? (1 mark)

Description	Marks
Comparison/control group	1
Total	1

(d) State **three** variables that would need to be controlled to ensure that the experiment was a fair trial. (3 marks)

Description	Marks
Any three of the following	
Age/gender	1–3
Same general health/previous health history	
Similar effects of asthma on blood oxygen concentration	
Similar daily exercise	
Same time of day for measuring blood oxygen concentrations	
Same method/volume/frequency of administration of bronchodilator	
Total	3

(e) Explain how, under normal conditions, a change in gas concentrations in the blood brings about a response that returns the concentrations to acceptable homeostatic levels. (5 marks)

Description	Marks
Any five of the following	
Chemoreceptors (in aorta, carotid artery and medulla oblongata) detect change (↓pH/↑CO_2)	1–5
Send message to (respiratory control centre) the medulla	
Message sent along nerves	
Intercostal muscles and diaphragm stimulated to increase rate of contraction/respiratory muscles stimulated to increase rate of contraction	
Increases depth and rate of breathing	
Increase O_2 concentration/↓CO_2/↑pH	
Total	5

Answers for Questions 34 and 36 taken from the 2017 ATAR Human Biology ratified marking key

Source: School Curriculum and Standards Authority, Human Biology 2017 ATAR Examination
https://senior-secondary.scsa.wa.edu.au/further-resources/past-atar-course-exams/human-biology-past-atar-course-exams

Question 34 **(12 marks)**

(a) (i) Why did the blood pH levels change? (2 marks)

Description	Marks
Increase in activity/metabolism/energy/cellular respiration/production of CO_2	1
(causing) Increase in hydrogen ion concentration/higher acidity/greater production of carbonic acid/production of lactic acid	1
Total	**2**

(ii) Describe the events that enable this change in the breathing rate to occur. (4 marks)

Description	Marks
Detected by chemoreceptors/carotid and aortic bodies	1
Send nerve impulses to the respiratory centre/medulla oblongata	1
Nerve impulses sent to respiratory muscles/diaphragm/intercostal muscles	1
Increased contraction of respiratory muscles	1
Total	**4**

(b) Under normal circumstances, the level of oxygen in the blood does not influence breathing rate. Under what circumstance will it have an effect and what effect will it be? (2 marks)

Description	Marks
When oxygen falls to very low levels	1
Causes increase in breathing rate	1
Total	**2**

Question 36 **(11 marks)**

(a) According to the information in the diagram, is Graves' disease a type of hypothyroidism or hyperthyroidism? (1 mark)

Description	Marks
Hyperthyroidism	1
Total	1

(b) Identify **two** symptoms you would expect someone with Graves' disease to display. (2 marks)

Description	Marks
Any 2 of:	
Increased metabolic rate	1–2
Higher than normal temperature	
Accelerated heart rate/heart palpitations	
Muscle weakness/trembling	
Sensitivity to heat	
Diarrhoea	
Sleeping difficulties	
Anxiety	
Sweating	
Irritability	
Nervousness/agitation	
Changes in menstruation	
Enlarged thyroid	
Weight loss	
Increased appetite	
Bulging eyeballs	
Total	2

(c) Explain how Graves' disease can be treated. (3 marks)

Description	Marks
Any 3 of:	
• Removal of thyroid gland/surgery on thyroid gland • Radioactive iodine • Antithyroid/iodo blocker drugs	1
• Thyroid cells damaged/killed/not functioning	1
• Replacement of thyroxine (T4)/Triiodothyronine • Synthetic hormones as replacement	1
Total	3

(d) Describe the process that, under normal circumstances, stimulates the release of thyroid stimulating hormone (TSH) from the pituitary gland. (5 marks)

Description	Marks
Low levels of thyroxine/thyroid hormones/decreased metabolism/decreased body temperature	1
Stimulates receptors in hypothalamus	1
Triggers release of TSHrf/releasing factors	1
Factors travel through blood capillaries	1
Stimulate anterior pituitary gland	1
Total	5