**Year 12 Human Biology**

**Unit 3: Science Inquiry - Homeostasis (5%)**

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**MARKING KEY**

**Task 3** Validation: **/48**

**TYPE:** Science Inquiry

**TIME:** 55 minutes

**Science Inquiry Homeostasis Validation**

Understanding the effect of the cold on the human body is an important military concern. Over 90,000 U.S Army and Air Force casualties during World War II were attributable to cold injury.

1. Humans tend to rely on behavioural thermoregulation to protect themselves against the cold.
2. Name the modulator that controls behavioural thermoregulation. (1 mark)

|  |  |
| --- | --- |
| **Name** | **Marks** |
| Cerebrum/ Cerebral Cortex / Frontal Lobe | 1 |

1. Name the effector which carries out the response for behavioural thermoregulation. (1 mark)

|  |  |
| --- | --- |
| **Name** | **Marks** |
| Skeletal muscles | 1 |

1. Describe two (2) behavioural responses which the soldiers in field operations during World War II would have relied on to prevent heat loss. (4 marks)

|  |  |
| --- | --- |
| **Describe** | **Marks** |
| Putting on clothes/jacket/jumper/long pants | 1 |
| Decrease heat loss via radiation/convection | 1 |
| Finding shelter away from the wind/rain | 1 |
| Decrease heat loss via convection/conduction | 1 |

When behavioural strategies are inadequate to maintain body temperature homeostasis, physiological responses are needed.

1. Sweating is one physiological response which helps to maintain body temperature.
2. Name the stimulus that initiates this response. (1 mark)

|  |  |
| --- | --- |
| **Name** | **Marks** |
| Increased core body temperature above 37 degrees Celsius | 1 |

1. Describe the feedback for how sweating helps to maintain body temperature. (2 marks)

|  |  |
| --- | --- |
| **Describe** | **Marks** |
| Increases heat loss | 1 |
| Via evaporation | 1 |

1. Is this an example of a positive or negative feedback? Explain your response. (2 marks)

|  |  |
| --- | --- |
| **Explain** | **Marks** |
| Negative feedback | 1 |
| The feedback aims to oppose the original stimulus by decreasing core body temperature. | 1 |

1. Explain the effect that sweating has on body fluid balance. (2 marks)

|  |  |
| --- | --- |
| **Explain** | **Marks** |
| Sweating decreases blood volume/reduces blood pressure | 1 |
| Increases osmotic pressure | 1 |

1. Name the receptor and identify the location of the receptor that detects this change in body fluid. (1 mark)

|  |  |
| --- | --- |
| **Explain** | **Marks** |
| Osmoreceptors in the hypothalamus | 1 |

1. Using your understanding of feedback loops, explain how metabolism maintains body temperature when it drops too low. (8 marks)

|  |  |
| --- | --- |
| **Explain** | **Marks** |
| Central Thermoreceptors in the Hypothalamus (detects decrease in body temperature) | 1 |
| Hypothalamus releases TSHrf via blood | 1 |
| Anterior Pituitary releases TSH via blood | 1 |
| Effector: Thyroid gland | 1 |
| Response: Increase in thyroxine increases basal metabolic rate | 1 |
| Increased cellular respiration | 1 |
| Increased heat production | 1 |
| Feedback: Increases core body temperature | 1 |

Students do not need to include to S.M.E.R.F here to get the marks.

In an experiment conducted in 1986, finger skin temperature measurements of three 50-70 year old men and a group of three younger men were taken when their hands were submerged in 4°C water for 30 minutes.

1. Complete the following based on the information above.

Aim: (1 mark)

|  |  |
| --- | --- |
|  | **Marks** |
| To investigate the finger skin temperature measurements of 50-70 year old men and younger men when their hands are submerged in 4°C water for 30 minutes. | 1 |

Must have all (straight from above)

Hypothesis: (2 marks)

|  |  |
| --- | --- |
|  | **Marks** |
| Younger/older men will maintain a higher finger skin temperature | 1 |
| when their hands are submerged in 4°C water for 30 minutes compared to the older/younger men. | 1 |

**Variables:**

Independent: (1 mark)

|  |  |
| --- | --- |
|  | **Marks** |
| Age of the men; 50-70 year old men and younger men | 1 |

Must have all and be specific.

Dependent: (1 mark)

|  |  |
| --- | --- |
|  | **Marks** |
| Finger skin temperature (°C) | 1 |

Controlled: (3 marks)

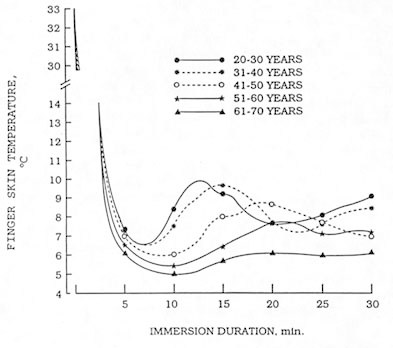
|  |  |
| --- | --- |
|  | **Marks** |
| Age group of participants; 50-70 for the older category and 20-40 for the younger category (must be specific) | Any 3 |
| Male gender |
| Temperature of the water is maintained at 4°C |
| How finger skin temperature is measured |
| Must be specific ie. Do not accept “age group” or “gender” or “measurement”   * Do not accept: sample size or trials (more appropriate answers than this)   Any other suitable controlled variable. |  |

1. Was this investigation valid and reliable? How could this be improved? (6 marks)

|  |  |
| --- | --- |
| **Description** | **Mark** |
| Reliability   * This experiment was not reliable. * The number of trials is not provided and there were only 3 individuals for each group (older and younger males). * Increase sample size: 30+ for each group OR Increase trials to at least 3 per person. | 1-3 |
| Validity   * This experiment was valid (must provide explanation to get this mark). * The controlled variables were maintained/only one variable was changed in the experiment. * Provide an example of a variable which was controlled and how.   OR   * The experiment was not valid (must provide explanation to get this mark). * Not enough information about the investigation was provided OR Provide suitable example of one variable not controlled   ie. Age was not controlled: only 50-70 year old males and younger males/no age category stated here   * Provide one improvement. | 1-3 |

**Results**

Use Figure One (below) to help you answer questions 5-8.



SOURCE: Adapted from Mathew et al. (1986).

1. Provide a brief description of these results for 20 - 30 year old males and 61 - 70 year old males after submerging their hand in the cold water for 30 minutes. (2 marks)

|  |  |
| --- | --- |
| **Describe** | **Marks** |
| 20-30 year old males had a higher finger skin temperature than 61-70 year old males after 30 minutes | 1 |
| Use data, example: younger males’ temperature was approx. 9 degrees and older males were approx. 6 degrees. | 1 |

1. Write a conclusion for these results. (2 marks)

|  |  |
| --- | --- |
|  | **Marks** |
| Supported or not supported hypothesis (refer to individual hypothesis) | 1 |
| Use data from the graph above to support response   * Must include values (approximate is okay) | 1 |

1. Using your knowledge of feedback loops, explain why there is a decrease in skin temperature when placed in the cold water. (8 marks)

|  |  |
| --- | --- |
| **Explain** | **Marks** |
| Stimulus: Decrease in core body temperature | 1 |
| Receptor: Central Thermoreceptors in the Hypothalamus | 1 |
| Modulator: Thermoregulatory Centre in the Brain | 1 |
| Transmission: Autonomic nervous system | 1 |
| Effector: Cutaneous arterioles | 1 |
| Response: Vasoconstriction reduces blood flow to the skin | 1 |
| Decrease heat loss via radiation | 1 |
| Feedback: Increase/maintain core body temperature | 1 |

Students do not need to include to S.M.E.R.F here to get the marks.

Reference

FIGURE 7-3, [Finger skin temperature measurements from...]. - Nutritional Needs In Cold And In High-Altitude Environments - NCBI Bookshelf. (2020). Retrieved 20 March 2020, from https://www.ncbi.nlm.nih.gov/books/NBK232852/figure/mmm00012/?report=objectonly

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