**MODULATOR**

**Control centre responsible for processing information received from receptor & sending information to effector**

**Alpha Cells in Islets of Langerhans in the pancreas secrete glucagon into the blood**

**Hypothalamus stimulates adrenal cortex by stimulating the release of ACTH from the anterior pituitary gland**

**Sympathetic nervous control stimulates the Adrenal medulla**

**STIMULUS**

**Change in the environment that causes system to operate. (Above or below the normal).**

**Decrease in blood glucose levels.**

**Below set point (90mg/100mL)**

**RECEPTOR**

**Detects change**

**Chemoreceptor in Alpha Cells in Islets of Langerhans in the pancreas**

**LOW BLOOD GLUCOSE**

**EFFECTOR**

**Carries out response counteracting effect of stimulus**

* **Liver**
* **Adrenal Cortex**
* **Adrenal Medulla**

**FEEDBACK**

**Achieved because original stimulus has been changed by the response**

**Increase in blood glucose levels. Alpha cells no longer stimulated to release glucagon. Negative feedback has occurred. Original stimulus has been reduced/eliminated.**

**RESPONSE**

**Action and processes (mechanism) of the effector**

* **Liver**
  + **Glycogenolysis (glycogen🡪glucose)**
  + **Gluconeogeneisis**
  + **(Fats/proteins 🡪 glucose)**
* **Adrenal Cortex**
  + **Secrete glucocorticoids (cortisol) which stimulates glycogenolysis and protein breakdown in muscles and conversion of amino acids to glucose in the liver.**
* **Adrenal Medulla**
  + **Secretes adrenaline and noradrenaline which stimulates breakdown of glycogen in the liver.**

**ALL RESPONSES INCREASE BLOOD GLUCOSE LEVELS**

**STIMULUS**

**Change in the environment that causes system to operate. (Above or below the normal).**

**Increase in blood glucose levels.**

**Above set point (90mg/100mL)**

**RECEPTOR**

**Detects change**

**Chemoreceptor in Beta Cells in Islets of Langerhans in the pancreas**

**HIGH BLOOD GLUCOSE**

**EFFECTOR**

**Carries out response counteracting effect of stimulus**

* **Liver**
* **Body cells**

**MODULATOR**

**Control centre responsible for processing information received from receptor & sending information to effector**

**Beta Cells in Islets of Langerhans in the pancreas secrete insulin into the blood**

**FEEDBACK**

**Achieved because original stimulus has been changed by the response**

**Decrease in blood glucose levels. Beta cells no longer stimulated to release insulin. Negative feedback has occurred. Original stimulus has been reduced/eliminated.**

**RESPONSE**

**Action and processes (mechanism) of the effector**

* **Liver**
  + **Glycogenesis (Glucose 🡪 glycogen)**
  + **Glucose converted to fat for storage**
* **Body Cells** 
  + **Glucose taken up (mainly by liver and skeletal muscles)**
  + **Increase in protein synthesis**

**ALL RESPONSES DECREASE BLOOD GLUCOSE LEVELS**

**STIMULUS**

**Change in the environment that causes system to operate. (Above or below the normal).**

**Increase in body temperature above set point**

**RECEPTOR**

**Detects change**

**Peripheral heat receptors in skin and mucous membranes.**

**Central thermoreceptors in the thermoregulatory centre of the hypothalamus.**

**VASODILATION**

**EFFECTOR**

**Carries out response counteracting effect of stimulus**

**Skin blood vessels (arterioles)**

**MODULATOR**

**Control centre responsible for processing information received from receptor & sending information to effector**

**Hypothalamus – nervous conduction via parasympathetic pathway.**

**RESPONSE**

**Action and processes (mechanism) of the effector**

**Vasodilation – widening of blood vessels. Increases blood flow through the vessels. Increases heat loss via conduction, convection and radiation.**

**FEEDBACK**

**Achieved because original stimulus has been changed by the response**

**Decrease in body temperature. Negative feedback has occurred. Original stimulus has been reduced/eliminated.**

**STIMULUS**

**Change in the environment that causes system to operate. (Above or below the normal).**

**Increase in body temperature above set point**

**RECEPTOR**

**Detects change**

**Peripheral heat receptors in skin and mucous membranes.**

**Central thermoreceptors in the thermoregulatory centre of the hypothalamus.**

**SWEATING**

**EFFECTOR**

**Carries out response counteracting effect of stimulus**

**Sweat glands**

**MODULATOR**

**Control centre responsible for processing information received from receptor & sending information to effector**

**Hypothalamus - initiates conduction along sympathetic pathway to activate the cooling process.**

**RESPONSE**

**Action and processes (mechanism) of the effector**

**Sweat glands release sweat. The evaporation of sweat from the surface of the skin cools the body down – increasing heat loss.**

**FEEDBACK**

**Achieved because original stimulus has been changed by the response**

**Decrease in body temperature. Negative feedback has occurred. Original stimulus has been reduced/eliminated.**

**STIMULUS**

**Change in the environment that causes system to operate. (Above or below the normal).**

**Increase in body temperature above set point**

**RECEPTOR**

**Detects change**

**Peripheral heat receptors in skin and mucous membranes.**

**Central thermoreceptors in the thermoregulatory centre of the hypothalamus.**

**THYROXINE**

**EFFECTOR**

**Carries out response counteracting effect of stimulus**

**Thyroid gland – stops releasing thyroxine into blood**

**MODULATOR**

**Control centre responsible for processing information received from receptor & sending information to effector**

**Hypothalamus – releases TSH inhibiting factor.**

**Anterior pituitary gland – stops releasing TSH**

**RESPONSE**

**Action and processes (mechanism) of the effector**

**Low levels of thyroxine in the blood**

**Decreased metabolic rate (cellular respiration) by body cells = decreased heat production**

**FEEDBACK**

**Achieved because original stimulus has been changed by the response**

**Decrease in body temperature. Negative feedback has occurred. Original stimulus has been reduced/eliminated.**

**STIMULUS**

**Change in the environment that causes system to operate. (Above or below the normal).**

**Increase in body temperature above set point**

**RECEPTOR**

**Detects change**

**Peripheral heat receptors in skin and mucous membranes.**

**Central thermoreceptors in the thermoregulatory centre of the hypothalamus.**

**BEHAVIOUR**

**EFFECTOR**

**Carries out response counteracting effect of stimulus**

**Cerebrum - Messages received here stimulate behavioural response via skeletal muscles**

**MODULATOR**

**Control centre responsible for processing information received from receptor & sending information to effector**

**Hypothalamus – Initiates nervous conduction to activate cooling processes**

**FEEDBACK**

**Achieved because original stimulus has been changed by the response**

**Decrease in body temperature. Negative feedback has occurred. Original stimulus has been reduced/eliminated.**

**RESPONSE**

**Action and processes (mechanism) of the effector**

**Conscious decision to:**

* **Take of clothes (increase heat loss via convection and radiation)**
* **Turn aircon/fan on (increase heat loss via convection)**
* **Increase body surface by spreading out (increase heat loss via convection and radiation)**
* **Reduce physical activity (decrease heat production)**
* **Stand in the shade (Decrease heat gain by radiation)**

**ALL OF THE ABOVE INCREASE HEAT LOSS (by conduction, convection or radiation) OR DESCREASE HEAT PRODUCTION**

**STIMULUS**

**Change in the environment that causes system to operate. (Above or below the normal).**

**Decrease in body temperature below set point**

**RECEPTOR**

**Detects change**

**Peripheral cold receptors in skin and mucous membranes.**

**Central thermoreceptors in the thermoregulatory centre of the hypothalamus.**

**SHIVERING**

**EFFECTOR**

**Carries out response counteracting effect of stimulus**

**Skeletal muscles**

**MODULATOR**

**Control centre responsible for processing information received from receptor & sending information to effector**

**Hypothalamus – Initiates nervous conduction via sympathetic pathway to activate warming processes**

**RESPONSE**

**Action and processes (mechanism) of the effector**

**Shivering – rhythmic oscillations of muscles causing tremors which generates heat.**

**FEEDBACK**

**Achieved because original stimulus has been changed by the response**

**Increase in body temperature. Negative feedback has occurred. Original stimulus has been reduced/eliminated.**

**STIMULUS**

**Change in the environment that causes system to operate. (Above or below the normal).**

**Decrease in body temperature below set point**

**RECEPTOR**

**Detects change**

**Peripheral cold receptors in skin and mucous membranes.**

**Central thermoreceptors in the thermoregulatory centre of the hypothalamus.**

**THYROXINE**

**EFFECTOR**

**Carries out response counteracting effect of stimulus**

**Thyroid gland – releases thyroxine into blood**

**MODULATOR**

**Control centre responsible for processing information received from receptor & sending information to effector**

**Hypothalamus – releases TSH releasing factor.**

**Anterior pituitary gland – stimulated to release TSH**

**RESPONSE**

**Action and processes (mechanism) of the effector**

**High thyroxine levels in blood. Body cells respond to thyroxine = increased metabolic rate (cellular respiration) = increased heat production**

**FEEDBACK**

**Achieved because original stimulus has been changed by the response**

**Increase in body temperature. Negative feedback has occurred. Original stimulus has been reduced/eliminated.**

**STIMULUS**

**Change in the environment that causes system to operate. (Above or below the normal).**

**Decrease in body temperature below set point**

**RECEPTOR**

**Detects change**

**Peripheral cold receptors in skin and mucous membranes.**

**Central thermoreceptors in the thermoregulatory centre of the hypothalamus.**

**VASOCONSTRICTION**

**EFFECTOR**

**Carries out response counteracting effect of stimulus**

**Skin blood vessels (arterioles)**

**MODULATOR**

**Control centre responsible for processing information received from receptor & sending information to effector**

**Hypothalamus – initiates nervous conduction via sympathetic pathway to activate warming process.**

**RESPONSE**

**Action and processes (mechanism) of the effector**

**Vasoconstriction – narrowing of blood vessels. Reduces blood flow through the vessels. Reduces heat loss via conduction, convection and radiation.**

**FEEDBACK**

**Achieved because original stimulus has been changed by the response**

**Increase in body temperature. Negative feedback has occurred. Original stimulus has been reduced/eliminated.**

**STIMULUS**

**Change in the environment that causes system to operate. (Above or below the normal).**

**Decrease in body temperature below set point**

**RECEPTOR**

**Detects change**

**Peripheral cold receptors in skin and mucous membranes.**

**Central thermoreceptors in the thermoregulatory centre of the hypothalamus.**

**ADRENALINE AND NORADRENALINE**

**EFFECTOR**

**Carries out response counteracting effect of stimulus**

**Adrenal medulla – secretes adrenaline and noradrenaline into the blood**

**MODULATOR**

**Control centre responsible for processing information received from receptor & sending information to effector**

**Hypothalamus – stimulates adrenal medulla by nervous conductions along a sympathetic pathway**

**RESPONSE**

**Action and processes (mechanism) of the effector**

**High levels of adrenaline and noradrenaline in the blood. Body cells respond = increased metabolic rate = increased heat production**

**FEEDBACK**

**Achieved because original stimulus has been changed by the response**

**Increase in body temperature. Negative feedback has occurred. Original stimulus has been reduced/eliminated.**

**STIMULUS**

**Change in the environment that causes system to operate. (Above or below the normal).**

**Decrease in body temperature below set point**

**RECEPTOR**

**Detects change**

**Peripheral cold receptors in skin and mucous membranes.**

**Central thermoreceptors in the thermoregulatory centre of the hypothalamus.**

**BEHAVIOUR**

**EFFECTOR**

**Carries out response counteracting effect of stimulus**

**Cerebrum - Messages received here stimulate behavioural response via skeletal muscles**

**MODULATOR**

**Control centre responsible for processing information received from receptor & sending information to effector**

**Hypothalamus – stimulates nervous conduction to activate warming processes.**

**FEEDBACK**

**Achieved because original stimulus has been changed by the response**

**Increase in body temperature. Negative feedback has occurred. Original stimulus has been reduced/eliminated.**

**RESPONSE**

**Action and processes (mechanism) of the effector**

**Conscious decision to:**

* **Put on clothes (decrease heat loss via radiation and convection)**
* **Turn heater on (increase heat gain by convection and radiation)**
* **Decrease body surface by spreading out (decrease heat loss via radiation and convection)**
* **Increase physical activity (increase heat production)**

**ALL OF THE ABOVE DECREASE HEAT LOSS (by conduction, convection or radiation) OR INCREASE HEAT PRODUCTION**