What are the effects of adrenaline on the body?

- Increased heart rate
- Dilated pupils
- Mental awareness increases
- Increased breathing rate
- Increased awareness
- Sensory threshold increases
- Bronchioles dilate
- Vasoconstriction in the arteries and arterioles
- Conversion of glycogen to glucose in the liver
- Peristalsis and digestion inhibited
- Hair raised

What are the advantages of these effects in a "Fight and Flight response"?

- An increased heart rate enables more oxygen and glucose to get to the cells for an increased rate of aerobic respiration.
- Dilated pupils allow more light to enter the eyes and therefore vision improves.
- An increased mental awareness causes an increase of focus on the task ahead.
- An increased breathing rate allows a quicker rate of gaseous exchange which in turn allows more oxygen to be transported around the body to get to its desired destination quicker.
- Increased awareness allows reaction times to things that the body wouldn't normally respond to is increased.
- The increase of the sensory threshold again allows reaction times to increase.
- The dilation of bronchioles allows more oxygen to get to the lungs which allows more gaseous exchange to take place.
- The vasoconstriction of the arteries and arterioles causes the blood pressure to increase, which causes the blood to travel quicker to get to its desired destination. (However, less blood is able to get to the heart)
- If more glycogen is converted to more glucose, then more of it can be used for an increased rate of aerobic respiration in the cells.
- Less blood gets to the gut which is beneficial so more glucose and oxygen can be transported to the muscle cells which prepares the organisms' body with more energy to run away from danger quickly.
- Raised hair not only makes an animal look scarier, but it increases the sensitivity of the body's response to touch.

The amazing pancreas!

Why is it that amazing?

- Insulin, which lowers your blood glucose, is produced in the islets of Langerhans glands. These are endocrine glands, which are ductless.
- Specialised α-cells and β-cells make hormones.
- α-cells make a peptide hormone called glucagon
- β-cells make a peptide hormone called insulin.

Adrenaline

Adrenaline is a protein hormone. Relatively speaking, protein molecules are too big to fit through the plasma membrane. So, when adrenaline attaches itself to the receptor in question, it's known as the **first messenger.** This triggers, with the catalysis of adenyl cyclase, the conversion of adenine triphosphate (ATP) into cAMP- the **second messenger.** This occurs in the **cytoplasm.**

When the cAMP levels increase, enzymes known as protein kinases are activated. The result is the catalysis of the production of glucagon, which is the peptide hormone that breaks down glycogen into glucose by glucogenesis.

This process can be put into context. Overall, cAMP is responsible for regulating the effects of adrenaline and glucagon.

Exam Question:

In anaerobic conditions pyruvate does not proceed to the link reaction. Describe the fate of pyruvate during anaerobic respiration in an animal cell and explain the importance of this action. [5] (OCR F214 Jan 2010)

IMPORTANT INFORMATION:

- *It's an animal cell, so I'll talk about lactic fermentation*
- *Pyruvate ends up as lactate*
- *Explain the significance of anaerobic respiration*

Mark scheme:

- Pyruvate converted to lactate.
- Pyruvate accepts hydrogen (atoms).
- Hydrogen from reduced NAD is catalysed by the enzyme lactate dehydrogenase.
- No oxygen to act as final hydrogen / electron acceptor.
- Therefore the link reaction, Krebs cycle, oxidative phosphorylation cannot take place. (All those reactions require oxygen).
- **SIGNIFICANCE MARK:** NAD is able to be recycled; this allows glycolysis to continue. Pyruvate continues to be made as a result.
- **YET ANOTHER SIGNIFICANCE MARK:** Some ATP can be still be produced as a result.

How is insulin secreted out of beta cells?

Beta cells are cells within the islets of Langerhans in the pancreas, which are responsible for secreting insulin into the blood in order to lower glucose concentration.
Beta cells have calcium ion channels and potassium ion channels. In a normal situation, the potassium ion channels are open, whereas the calcium ion channels are shut. This means K+ ions can diffuse out of the beta cell, thus making the inside of the beta cell more negative than the outside.
However, when you eat, and your blood glucose concentration increases, there are more molecules of glucose outside of the beta cell than those of the inside. So, the glucose molecules can diffuse into the beta cell down the concentration gradient via the GLUT2 protein.
Once inside the cell, the glucose molecules undergo cellular aerobic respiration, and ATP is therefore synthesised. This means that the concentration of ATP increases in the cell. This increase in ATP concentration causes the potassium ion channels to shut (due to the caused conformational changes of the protein channels), thus making K+ ions impermeable to the membrane. No K+ can diffuse out of the cell, so the inside of the beta cell is now more positive than the outside. This change in potential difference causes the voltage gated calcium ion channels to suddenly open, allowing free Ca2+ ions to start diffusing into the cell down their concentration gradient. The calcium ions will then bind to the vesicles containing insulin inside the beta cell, and thus cause conformational changes of the vesicles. This means that the vesicles will move up to the cell surface membrane, fuse to it, and release the insulin molecules into the blood by exocytosis. Once in the blood, the insulin can start lowering the blood glucose concentration, thus returning it back to normal, through the process of negative feedback.