Biology of Stress Introduction

Let's get something straight right from the start. The body's reaction to stress is old fashioned. In the modern world, in the vast majority of stress situations the body's response to stress causes more harm than good. However, in the olden days, like hundreds of thousands of years ago, our present day response to stress would have been a lifesaver.

But what is stress?

A stressor is defined as:

What is acute stress, give examples.

What is chronic stress, give examples.
Bodily Response to Stress

Explain why the bodily response to stress 10,000+ years ago was useful.

Explain why the bodily response to stress is harmful in modern 21st century society.
Autonomic Nervous System (ANS)

This controls the functions that we have no conscious control over such as digestion, temperature and heart rate. It can be split into two parts:

<table>
<thead>
<tr>
<th>Sympathetic</th>
<th>Parasympathetic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increases heart rate</td>
<td>Decreases heart rate</td>
</tr>
<tr>
<td>Releases glucose into blood</td>
<td>Stores glucose in the liver as glycogen</td>
</tr>
<tr>
<td>Dilates pupils</td>
<td>Contracts pupils</td>
</tr>
<tr>
<td>Slows digestion</td>
<td>Returns digestion to normal</td>
</tr>
</tbody>
</table>

It's obvious from this that the sympathetic nervous system is responsible for the stress response! The Parasympathetic is left to return the body to normal when the threat has passed; it recharges the batteries for the next alert if you like.

An area in the brain called the hypothalamus controls the body's response to stress. This is situated right next to the pituitary gland (sometimes referred to as the master gland because it controls the others) and both are located in the middle of the brain just behind the upper part of your nose!

In the stress response the Pituitary gland does two things.

1. It sends nerve messages to the adrenal medulla (part of the adrenal gland)
2. It sends a chemical ACTH to the adrenal cortex (another part of the adrenal gland).

<table>
<thead>
<tr>
<th>Adrenal Medulla</th>
<th>Adrenal cortex</th>
</tr>
</thead>
<tbody>
<tr>
<td>Triggers the sympathetic nervous system and releases adrenaline.</td>
<td>Releases corticosteroids into bloodstream</td>
</tr>
<tr>
<td>This produces the fight or flight response:</td>
<td>This causes:</td>
</tr>
<tr>
<td>• Increased heart rate</td>
<td>• Liver to release glucose</td>
</tr>
<tr>
<td>• Slows digestion</td>
<td>• Inhibits immune response especially inflammation and production of white blood cells.</td>
</tr>
<tr>
<td>• Dilates pupils</td>
<td>• Convert fats/proteins into glucose.</td>
</tr>
<tr>
<td>• Releases glucose into blood</td>
<td></td>
</tr>
</tbody>
</table>
The Body's Response to Stress

Firstly, our body judges a situation and decides whether or not it is stressful. This decision is made based on sensory input and processing (i.e. the things we see and hear in the situation) and also on stored memories (i.e. what happened the last time we were in a similar situation).

If the situation is judged as being stressful, the HYPOTHALAMUS (at the base of the brain) is activated.

**POINT TO NOTE** - In the next few pages, you will look at the HPA and SAM systems in more detail. Be prepared for some serious biological terms, but don’t worry if you can’t remember these straight away - it will come with practise!
The Sympathomedullary (SAM) Pathway

The hypothalamus also activates the adrenal medulla. The adrenal medulla is part of the ANS which secretes adrenaline. This hormone gets the body ready for a fight or flight response. Physiological reaction includes increased heart rate.

The Hypothalamic Pituitary-Adrenal (HPA) System

Here, in the endocrine (hormone) system, the hypothalamus directs the pituitary gland to release a stress hormone ACTH. This in turn, acts on the adrenal cortex, which is stimulated to release the hormone such as corticosteroid + glucose which helps to increase the body’s energy level over a longer period of time.
The Body’s response to ACUTE stress (the body’s IMMEDIATE response to stress)

⇒ The SYMPATHOMEDULLARY (SAM) PATHWAY

Situation is appraised and perceived as Stressful

Hypothalamus is alerted. This recognises the stress is **ACUTE** so it activates the SYMPATHOMEDULLARY Pathway

This activates the SYMPATHETIC branch of the ANS.

ANS stands for A__________________
N_______________ S___________

This then stimulates the A_______________
M______________. This is located just above the
K_______________. It secretes the hormones
A_________________________ into the bloodstream.

This prepares the body for F_____________ or
F_____________ and as such causes a number of physical (bodily) changes, including increased heart and breathing rates, dilated pupils and reduction in digestive system

However, the body cannot maintain this increased level of activity for long periods of time and P_______________ branch of the ANS

This is a COUNTERSHOCK response and serves to return the body back to its Natural resting state (e.g. it reduces heart rate and breathing rate, restores activity in the digestive system...)
The Body’s response to CHRONIC stress (the body’s LONG TERM response to ONGOING stressors)

⇒ The HYPOTHALAMIC PITUITARY ADRENAL System

Situation is appraised and perceived as stressful.

H_______________________ is alerted. This recognises the stress is CHRONIC.

Hypothalamus activates the P______________
G_______________ in the brain.

The P______________ G______________ causes the release of several hormones, including ACTH, which stands for A______________________________ hormone.

The release of ACTH stimulates the A______________ C______________ (another part of the adrenal glands) to release a range of hormones called C________________________.

These help to control blood sugar levels and make fats available for energy.

Bad effect of these hormones include suppression of the bodies I________ S__________
Recap - Physiological Responses to Stress

Stressor

Hypothalamus

Sympathomedullary pathway

Hypothalamic Pituitary – Adrenal System

ACTH Hormone

Increased heart and breathing rates
Saliva production slows (dry mouth)
Pupils dilate

Causes liver to release stored glucose, maintaining a ready supply of fuel for the body
Suppresses the immune system
Inhibit digestive system

http://www.simplypsychology.pwp.blueyonder.co.uk/
Acute stress: The sympathomedullary pathway

Across
1. Experienced when a person's perceived demands exceed their perceived ability to cope
7. The neurotransmitter released by the SNS to activate internal body organs
8. A pathway that is made up of the SNS and the SAM
9. Immediate stress on the body

Down
2. A branch of the SNS that arouses an animal to ready for fight or flight
3. Released by the SAM system to alert the animal
4. Neurons of the SNS travel to this so it releases adrenaline
5. A system that controls itself
6. A branch of the SNS that returns the animal to a state of relaxation
7. These travel to every organ and gland in the body to prepare for rapid action
Bodily Responses to Stress

Stressor

The Sympathomedullary Pathway

Higher brain centres

Hypothalamus

Adrenocorticotrophic hormone (ACTH) released into bloodstream

Pituitary gland

Adrenal cortex

Corticosteroid released into bloodstream

Adrenal medulla

Autonomic nervous system

Increased heart and breathing rates

‘Fight or Flight’ Response

Reduced activity in stomach

Glucose released into bloodstream to provide energy

Saliva production slows (dry mouth)

Pupils dilate

Suppresses the immune system.

Activation and effects of the long-term stress response are similar to those of the short-term, however maintaining a raised heart and breathing rate, inhibited digestion and so on over prolonged periods of time have negative health consequences.

Causes liver to release stored glucose, maintaining a ready supply of fuel for the body.