**hormone:** insulin

**gland:** pancreas, in beta-cells of islets of Langerhans

**target:** general, non-target

**function:** to decrease blood glucose

---

**overstimulation problems:**

**understimulation** understimulation may cause diabetes

**problems:**

---

**stress:** high blood sugar levels

**receptor:** beta-cells of islets of Langerhans

**message sent:** increase insulin production

**effector:** glucose is converted into glycogen, in liver and muscles

**feedback:** decreased blood glucose

---

**hormone:** glucagon

**gland:** pancreas, in the alpha-cells of the islets of Langerhans

**target:** general, non-target

**function:** to increase blood glucose

---

**overstimulation problems:**

**understimulation** understimulation may cause hypoglycemia

**problems:**

---

**stress:** low blood sugar levels

**receptor:** alpha-cells of islets of Langerhans

**message sent:** increase glucagon secretion

**effector:** glycogen is converted to glucose in liver and muscles

**feedback:** increased blood glucose
**hormone:** epinephrine (or adrenalin)
**gland:** adrenal medulla
**target:** general, non-target
**function:** increases blood sugar (converts glycogen to glucose), heart rate, breathing rate, cell metabolism; dilates blood vessels and the irises of the eyes

**overstimulation problems:**

**understimulation problems:**

**stress:** short-term stress or threat

**receptor:** hypothalamus
**message sent:** spinal cord cells stimulate adrenal medulla to secrete epinephrine
**effector:** adrenal medulla releases epinephrine
**feedback:** body responds to epinephrine, recovers from stress

---

**hormone:** cortisol
**gland:** adrenal cortex
**target:** general, non-target
**function:** increases the concentration of amino acids, which are converted to glucose in the liver, or used for protein synthesis to repair cells, converts fats to glucose

**overstimulation problems:**

**understimulation problems:**

**stress:** long-term stress

**receptor:** hypothalamus
**message sent:** tells pituitary gland to release ACTH, which signals the adrenal cortex to release cortisol
**effector:** adrenal cortex releases cortisol into bloodstream
**feedback:** body responds to cortisol, recovers from stress
**hormone:** parathyroid hormone (PTH)  
**gland:** parathyroid gland  
**target:** kidneys, intestine, bones  
**function:** increases levels of calcium in blood and decrease phosphate levels  

**overstimulation problems:**  

**understimulation problems:** if too little calcium and phosphate are absorbed from foods, rickets may develop  

**stress:** decreased calcium levels or increased phosphate levels  

**receptor:** parathyroid gland  
**message sent:** n/a  
**effector:** parathyroid releases PTH  
**feedback:** PTH stimulates intestines to absorb more calcium, kidneys to reabsorb more calcium and bones to release calcium into the blood

**hormone:** calcitonin  
**gland:** thyroid gland  
**target:** bone cells  
**function:** decreases calcium levels in blood by increasing calcium uptake levels in bone cells  

**overstimulation problems:**  

**understimulation problems:**  

**stress:** increased or decreased blood calcium levels  

**receptor:** hypothalamus and pituitary gland  
**message sent:** pituitary gland increases or decreases TSH secretion  
**effector:** change in TSH levels tells the thyroid to increase or decrease calcitonin secretion  
**feedback:** blood calcium levels decrease
**hormone:** thyroxin

**gland:** thyroid gland

**target:** general, non-target

**function:** regulates the metabolism of cells

<table>
<thead>
<tr>
<th>overstimulation</th>
<th>understimulation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>problems:</strong></td>
<td>TSH still being produced may cause the thyroid to become overstimulated &amp; enlarged</td>
</tr>
<tr>
<td>hyperthyroidism: bulging eyes, increased heart rate, nervousness</td>
<td></td>
</tr>
</tbody>
</table>

**stress:** metabolic rate change (too high or low)

**receptor:** hypothalamus and pituitary gland

**message sent:** pituitary gland increases or decreases TSH secretion

**effector:** change in TSH levels tells the thyroid to increase or decrease thyroxin secretion

**feedback:** the change in the level of thyroxin will normalize the metabolic rate of the organism as well as the blood sugar level