Kingdom Animalia: 
Phylum Chordata 
and 
Endocrine and 
Immune systems
Endocrine System:
Glands that send messages via chemicals (hormones)

(f) Endocrine system: secretes hormones that regulate body

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Hormones coordinate body functions

Hormone’s Path:
production cell → blood → target cell

Production cell:
part of the *endocrine* gland

Target cell:
cell that has the receptors to this particular hormone
It will carry a response after hormone is recognized

Hormone-receptor recognition is very important to regulate the body’s functions
Endocrine Disruptors are synthetic chemicals that disrupt the endocrine system

Some man made chemicals have a similar molecular shape to hormones.

If these chemicals bind to the receptors intended for a hormone, they cause an unintended response.

Frogs, crocodiles, polar bears, fish, bald eagles and are some of the documented cases.

Why is this of concern to us?

Hormone receptors are highly conserved across vertebrates.

Most synthetic chemicals are not regulated or tested.

<table>
<thead>
<tr>
<th>Chemical/Element</th>
<th>Common Usage</th>
<th>Example Hormone Target</th>
<th>Organism Type Impacted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polybrominated Diphenyl Ethers (PBDEs)</td>
<td>Flame retardants</td>
<td>Thyroid</td>
<td>Mammals, Birds, Reptiles, Fish</td>
</tr>
<tr>
<td>DDT</td>
<td>Insecticide</td>
<td>Estrogen</td>
<td>Mammals, Birds, Reptiles, Amphibians, Fish, Invertebrates</td>
</tr>
<tr>
<td>PCBs</td>
<td>Industrial</td>
<td>Cortisol</td>
<td>Mammals, Birds, Reptiles, Amphibians, Fish, Invertebrates</td>
</tr>
<tr>
<td>Cadmium</td>
<td>Batteries</td>
<td>Adrenaline</td>
<td>Mammals, Birds, Fish</td>
</tr>
<tr>
<td>Fenoxycarb</td>
<td>Insecticide</td>
<td>Juvenile</td>
<td>Invertebrates</td>
</tr>
<tr>
<td>Bisphenol A</td>
<td>Plasticizer</td>
<td>Estrogen</td>
<td>Mammals, Birds, Amphibians, Fish, Invertebrates</td>
</tr>
<tr>
<td>Nonylphenol</td>
<td>Plasticizer</td>
<td>Estrogen</td>
<td>Mammals, Birds, Amphibians, Fish, Invertebrates</td>
</tr>
</tbody>
</table>

Many endocrine-related diseases and disorders are on the rise.
- Large proportions (up to 40%) of young men in some countries have low semen quality, which reduces their ability to father children.
- The incidence of genital malformations, such as non-descending testes (cryptorchidisms) and penile malformations (hypospadias), in baby boys has increased over time or levelled off at unfavourably high rates.
- The incidence of adverse pregnancy outcomes, such as preterm birth and low birth weight, has increased in many countries.
- Neurobehavioural disorders associated with thyroid disruption affect a high proportion of children in some countries and have increased over past decades.
- Global rates of endocrine-related cancers (breast, endometrial, ovarian, prostate, testicular and thyroid) have been increasing over the past 40–50 years.
- There is a trend towards earlier onset of breast development in young girls in all countries where this has been studied. This is a risk factor for breast cancer.
- The prevalence of obesity and type 2 diabetes has dramatically increased worldwide over the last 40 years. WHO estimates that 1.5 billion adults worldwide are overweight or obese and that the number with type 2 diabetes increased from 153 million to 347 million between 1980 and 2008.
Tips to reduce your ED exposure

- Eat fresh food, rather than canned.
- Avoid cash-register receipts.
- Avoid plastics marked with "PC" for polycarbonate, or recycling number 7. Don't store or cook food in plastics of any kind, including plastic wrap made from No. 3 plastic.
- Eat less meat, fish, milk, eggs and butter.
- Buy organic produce.
- Choose a water filter that will remove atrazine, perchlorate, lead, arsenic and other chemicals.
- Avoid personal care products with "fragrance" in the list of ingredients.
- Be sure to consume the recommended amount of iodine, iron, calcium and Vitamin C.
- Use a vacuum cleaner with a HEPA filter.
- Don't eat fish high on the food chain, like tuna, swordfish and shark.
- Don't use non-stick pans, or products with stain- and water-resistant coatings.
Pancreas secretes insulin and glucagon

Function:
Manage blood glucose levels
**Diabetes mellitus:**

two different causes for high blood glucose levels

- **Blood sugar response 1:** Sugary foods
- **Blood sugar response 2:** Refined (white) carbs
  - White bread
  - White rice
  - White pasta
- **Blood sugar response 3:**
  - Whole grains
  - Fruits & veggies
  - Legumes

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**Healthy**
- Insulin
- Insulin receptor
- Glucose
- GLUT4

**Type I Diabetes**
- Insulin
- Insulin receptor
- Glucose
- GLUT4

**Type II Diabetes**
- Insulin
- Insulin receptor
- Glucose
- GLUT4
Immune System and other defense mechanisms

Who should we defend our self against?

How do we defend ourselves?
Two kinds of defense: innate and acquired

**Nonspecific defenses (innate)**
- Present at birth
- Do not distinguish one intruder from another
- 1st and 2nd line of defense

**Specific defenses (acquired)**
- Customized response to a particular kind of intruder
- First the intruder is identified and then a response is customized
- 3rd line of defense
Non-specific Barrier Immunity – First Line of Defense

Surface (physical) Barriers – intact skin, hair

specialized membranes – mucus

Normal flora - competitors, inhibitors

If an organism crosses these barriers it encounters the second line of defense:

inflammatory response, which is also a nonspecific defense.
2nd line of defense: The inflammatory response

The area affected gets red, swollen, pain, and warm

Signs of a inflammatory response

Cells produce

Histamine $\rightarrow$ swelling $\rightarrow$ benefit?
Prostaglandins $\rightarrow$ pain signals $\rightarrow$ benefit?
Pyrogens $\rightarrow$ fever $\rightarrow$ benefit?

Aspirin and ibuprofen are anti-inflammatory, what are they preventing?
Third line of defense: Antibodies

Some organisms escape the inflammatory response and enter the blood beneath the skin. The blood carries these organisms to the lymph nodes where this third line of defense develops.

Characteristics:

Specific

*They have receptors that are specific to a molecule (antigen) of the invader.*

Acquired

*Not present at birth, only customized after first exposure.*

Memory

*Second exposure: response is faster.*
Acquiring Specific-Immunity: breast milk, vaccines, others

**INDUCED IMMUNITY**
Using antibodies to resist specific diseases

**ACTIVE IMMUNITY**
Antibodies produced in the person’s body

- **Natural**
  - Pathogens enter the body in a natural manner.
  - *e.g.* catching a cold.

- **Artificial**
  - The pathogen is introduced into the body as a vaccine.
  - *e.g.* being immunised or vaccinated for polio.

**PASSIVE IMMUNITY**
Antibodies from another organism enter the person’s body

- **Natural**
  - Antibodies enter a person in a natural manner.
  - *e.g.* antibodies cross the placenta into the foetus.

- **Artificial**
  - Antibodies are injected into a person.
  - *e.g.* anti-tetanus injections.

Why and when do vaccines work?
Phylum Chordata: animals with a chord

Unique combination of four characteristics present at some stage in development:
- notochord (support rod, replaced by backbone)
- nerve cord (spinal cord)
- pharyngeal slits (feeding ➔ respiratory gills ➔ feeding jaws or hearing inner ear)
- post-anal tail (extension beyond anus, later reduced)
Advantages of each feature:

- **Vertebrae**

- **Jaws**

  Move on to land

  - **Lungs**
  - **Legs**
  - **Amniotic egg (and internal fertilization)**
  - **Feathers and hair (and endothermy)**
Important Chordates

Yondelis is an ovarian cancer drug from a sea squirt

Poison From Frog Skin Leads to a Painkiller

Diabetes drug, Byetta, stems from Gila monster spit