Gut-sensor axis:
Biosystems sensors based on semiconducting polymers.

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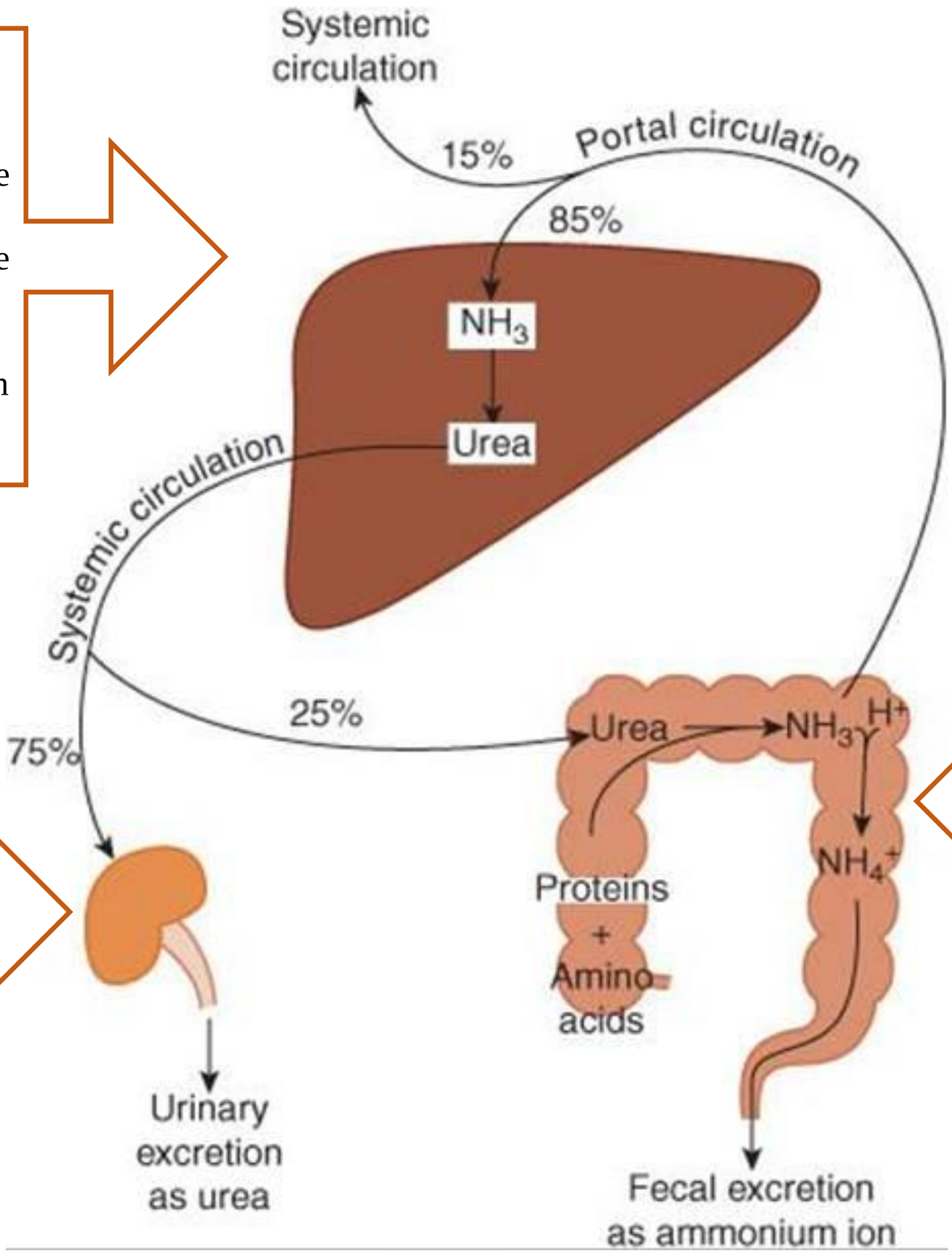
1. Liver

Urea is a nitrogen-containing waste product produced by the **liver** which is transported via the bloodstream and excreted in urine, sweat, and faeces [1] . The amount of urea produced is strongly correlated with the quantity of proteins consumed in the diet [2].

3. Kidneys

The **kidneys** can no longer convert the high amount of ammonia and ammonium molecules (which crossed the epithelial barrier and are present in the blood stream) into urea [5]. High ammonia levels present in the blood, colon and breath will therefore be an indicator of chronic kidney disease (CKD) [6].

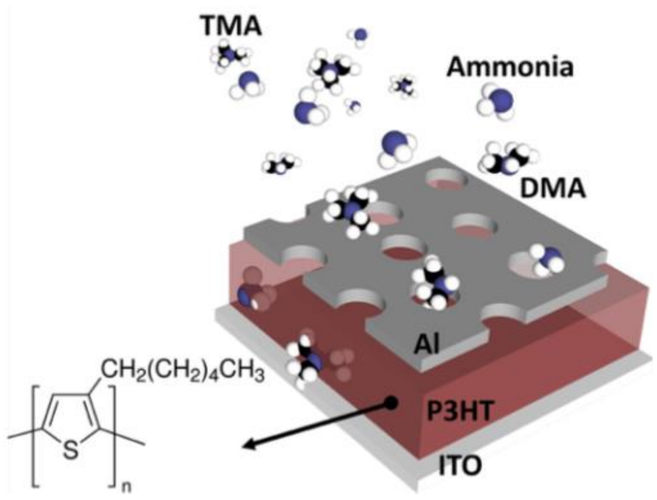


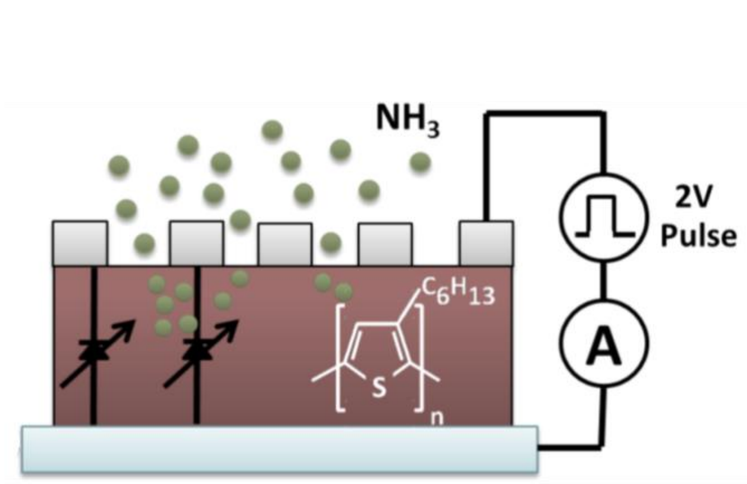
2. Gut

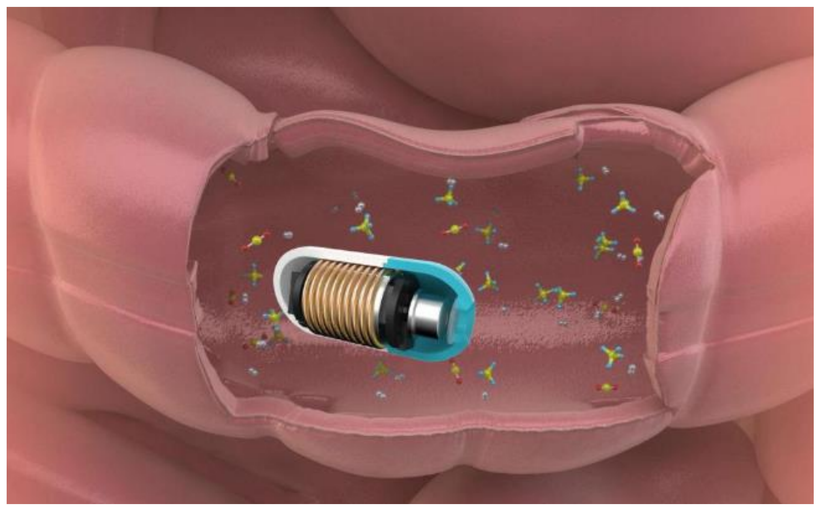
Preliminary studies found that **gut bacteria** use urea as amino acid source for the synthesis of new cell materials causing bacterial overgrowth [3] . Urea derived ammonia (NH3) and ammonium ions (NH4+) excreted by the gut bacteria can unsettle the tight junctions which are present between enterocytes and operate as epithelial barrier to prevent microbiota from entering the colon tissues [4].

4. Ammonia sensor fabrication

Fabrication of a gas sensor by colloidal photolithography: Containing a rigid glass (ITO) layer, conducting polymer (P3HT) and aluminum counter-electrode







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Picture taken from https://doctorlib.info/physiology/review/33.html and Chang, L. Y. et al. (2017) 'One-Minute Fish Freshness Evaluation by Testing the Volatile Amine Gas with an Ultrasensitive Porous-Electrode-Capped Organic Gas Sensor System', ACS Sensors, 2(4). doi: 10.1021/acssensors.6b00829.

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