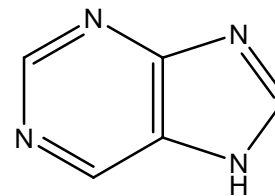


## The Inner World of Pee

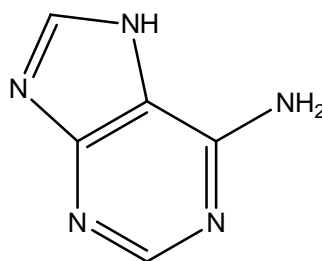


When it comes to getting rid of excess amino acids from diet and dead cells, animals have three basic choices: turn them to **ammonia**( $\text{NH}_3$ ), **urea**( $\text{CH}_4\text{N}_2\text{O}$ ) or **uric acid**( $\text{C}_5\text{H}_4\text{N}_4\text{O}_3$ ). For humans and most mammals, the sensible option is urea. Ammonia would be too toxic to circulate in the bloodstream. It's too bad because from an energy-standpoint, ammonia is the cheapest to produce. Fish and other animals that lay their eggs in the water can enjoy this advantage because dilution in lake- or sea water renders the potential toxin innocuous to the developing eggs.

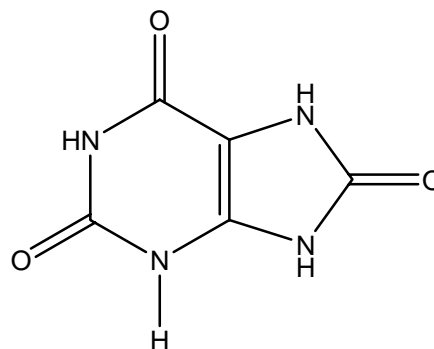
Any embryo that develops within a shell can ill-afford to produce either ammonia or urea. Both are water-soluble and would poison the little bird or snake's food supply. Such animals consequently produce insoluble uric acid. This happens to be the same end-product of our **purine** metabolism. (a purine is a compound similar to adenine, a basic component of key part of DNA and ATP.) But our urine normally contains very small amounts of uric acid (between 3.6 and 8.3 mg/dL). When concentrations run high, a condition known as gout ensues. Gravity causes the crystals to accumulate in the toes, resulting in pain and discomfort. Vegetarians often have very low levels of uric acid because meat is rich in purines. It's one of a few examples of how urine analysis can reveal dietary preferences.



purine



adenine



1*H*-purine-2,6,8(3*H*,7*H*,9*H*)-trione  
(commonly known as **uric acid**)

How do we produce urea? Our liver degrades many of the amino acids to ammonium ion, which is toxic, so it combines this poison with carbon dioxide, and the ensuing product enters what is known as the urea cycle, the first metabolic cycle ever to be understood in detail. The urea molecule's second nitrogen atom enters the cycle via aspartate. After conversion to arginine, hydrolysis causes the urea molecule to break off. The kidneys filter out the urea, and it's peed out with trace amounts of uric acid.

