NUCLEIC ACID METABOLISM AND RELATED DISEASES I

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Advance Clinical Biochemistry II (MA 406)

Summer Semester

Week one

12/08/2025

Objectives

- **At the end of this lesson, the students should be able to:**
- Understand the underline principle of purine metabolism
- Familiarize themselves with the terminology involves
- Make sense of the molecules at different levels.
- Understand the biomedical importance of purine metabolism.

Classroom policy

1. **Attendance:** Strongly encouraged to attend classes regularly and participate during lectures.

2. **Lateness:** Lateness to class is disruptive and prohibited

3. **Electronic devices:** Any form of device that could distract the class is not allowed to be used.

4. **Talking and improper movement: S**ide conversations and restlessness during lectures are distracting.


Expectations

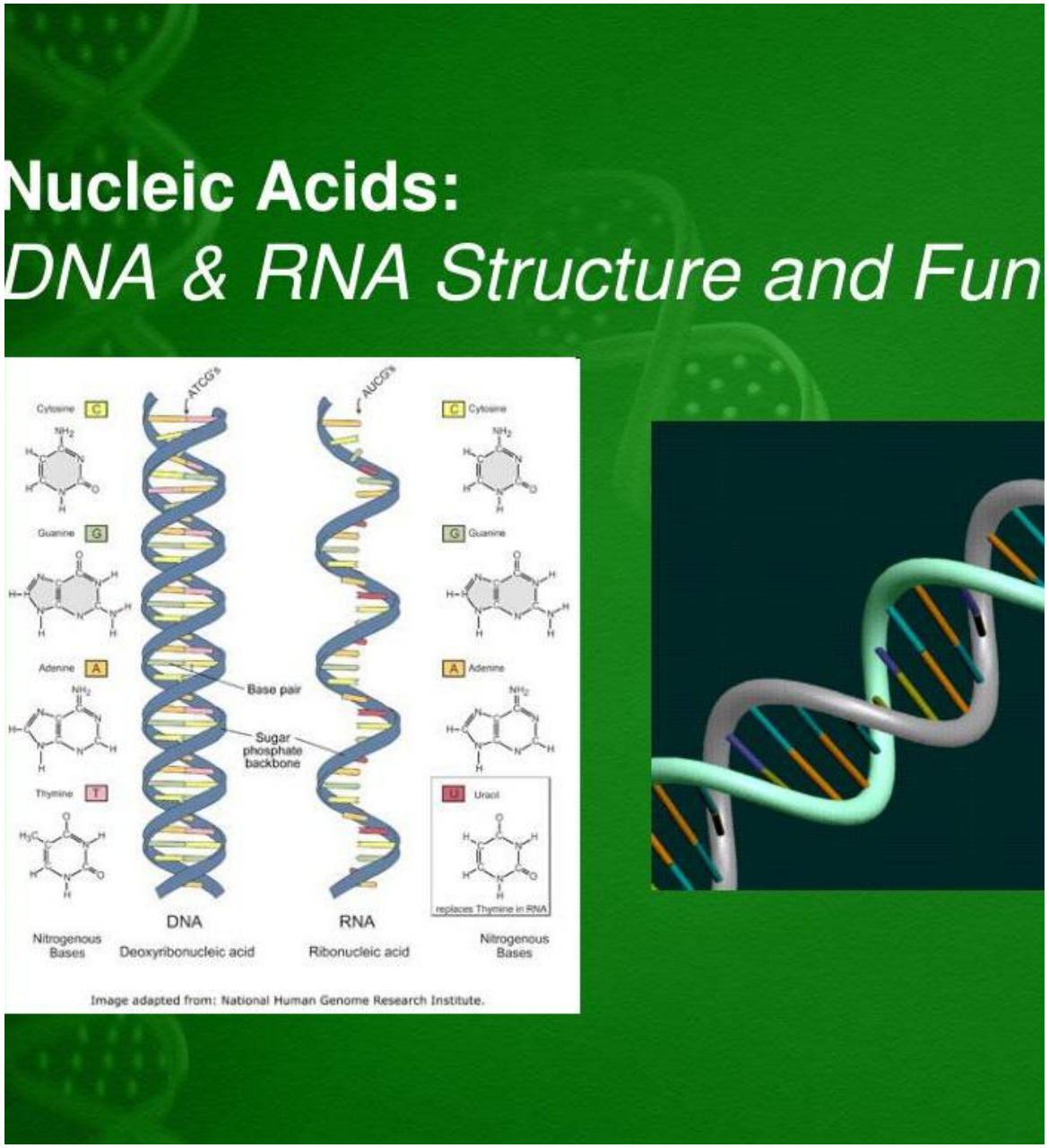
From me

1. Knowledge and expertise
2. Effective communication
3. Accessibility and availability
4. Respect for diversity
5. Making the environment Scientific
6. Listening to new ideas
7. Quick response to inquiries
8. Assessment and feedback

From you

1. Active Participation in discussions
2. Response to ambiguous statements
3. Self-respect and respect for all.
4. Note-taking during lectures
5. Utilising the office hours effectively
6. Early preparations for quizzes and exams
7. Honesty and Transparency
8. And many more

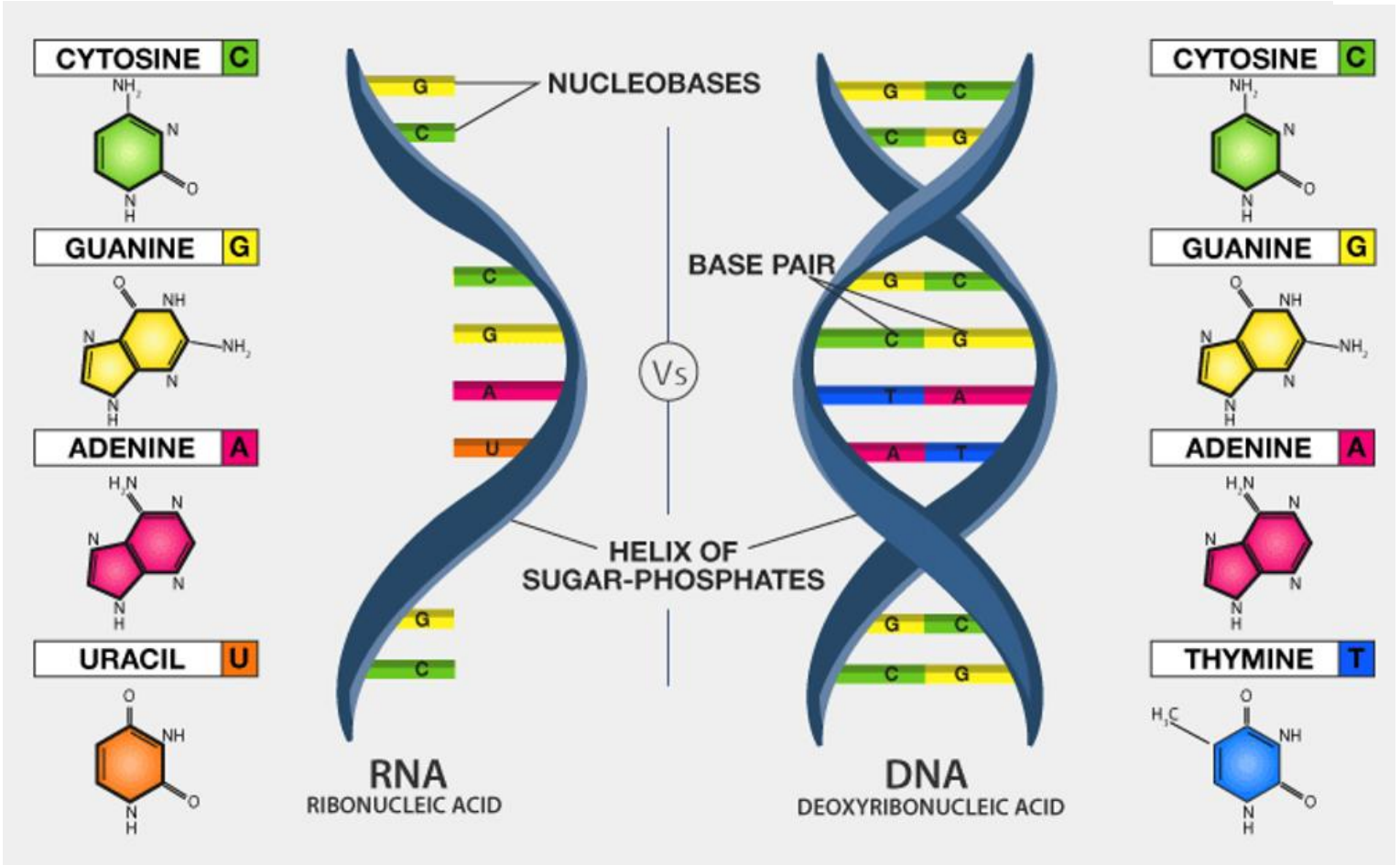
- Nucleic Acid metabolism and associated diseases
- Biochemistry of the nervous system and cerebrospinal fluid
- Enzymes in clinical diagnosis
- Cancer Biochemistry (malignancy and tumor markers)
- Biochemistry in pregnancy and antenatal screening
- Biochemistry in pediatrics and in elderly persons
- Biochemistry of aging and related diseases



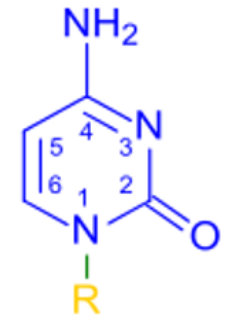
Nucleic acid

- DNA: A polynucleotide primary genetic material of all cells, consisting of a poly sugar-phosphate backbone with purine and pyrimidine bases.
- RNA: A polynucleotide that is unique among biological macromolecules in that it can encode genetic information and serve as an abundant structural component of cells.

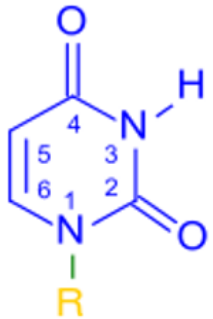
- The large molecules required for life.
- Built from smaller organic molecules.
- There are four major biological macromolecules.
- Together, these molecules form most of a cell's mass.



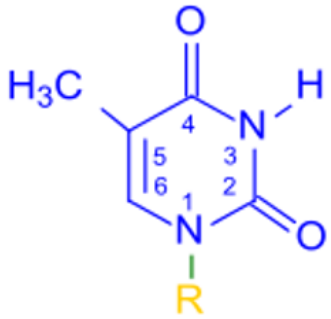
Pyrimidines



Cytosine



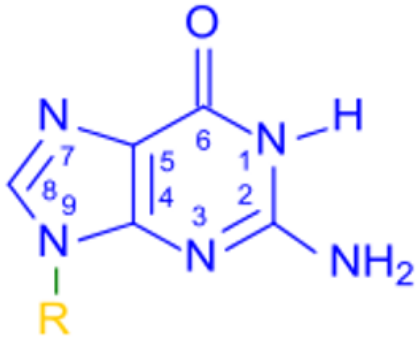
Uracil



Thymine

Purines

Adenine



Guanine

Nitrogenous bases

- Purines and pyrimidines are heterocyclic aromatic compounds.
- They form an important component of nucleotide when combined with sugar and phosphate groups.
- Purines include adenine and guanine, while pyrimidines include thymine (DNA), uracil (RNA), and cytosine in both.

Cont.

- **Purine:** Adenine (A) & Guanine (G)
- **Pyrimidine:** Thymine (T), Uracil (U), & Cytosine (C)
- **Other minor bases:** Hypoxanthine & Xanthine
- **Nucleosides:** 2 components (Base + Sugar):

- A nitrogenous base: **(**Adenine, guanine, thymine, or cytosine) + Pentose sugar (Deoxyribose) in DNA.
- A nitrogenous base: **(**Adenine, guanine, cytosine or uracil) + Pentose sugar (Ribose) in RNA

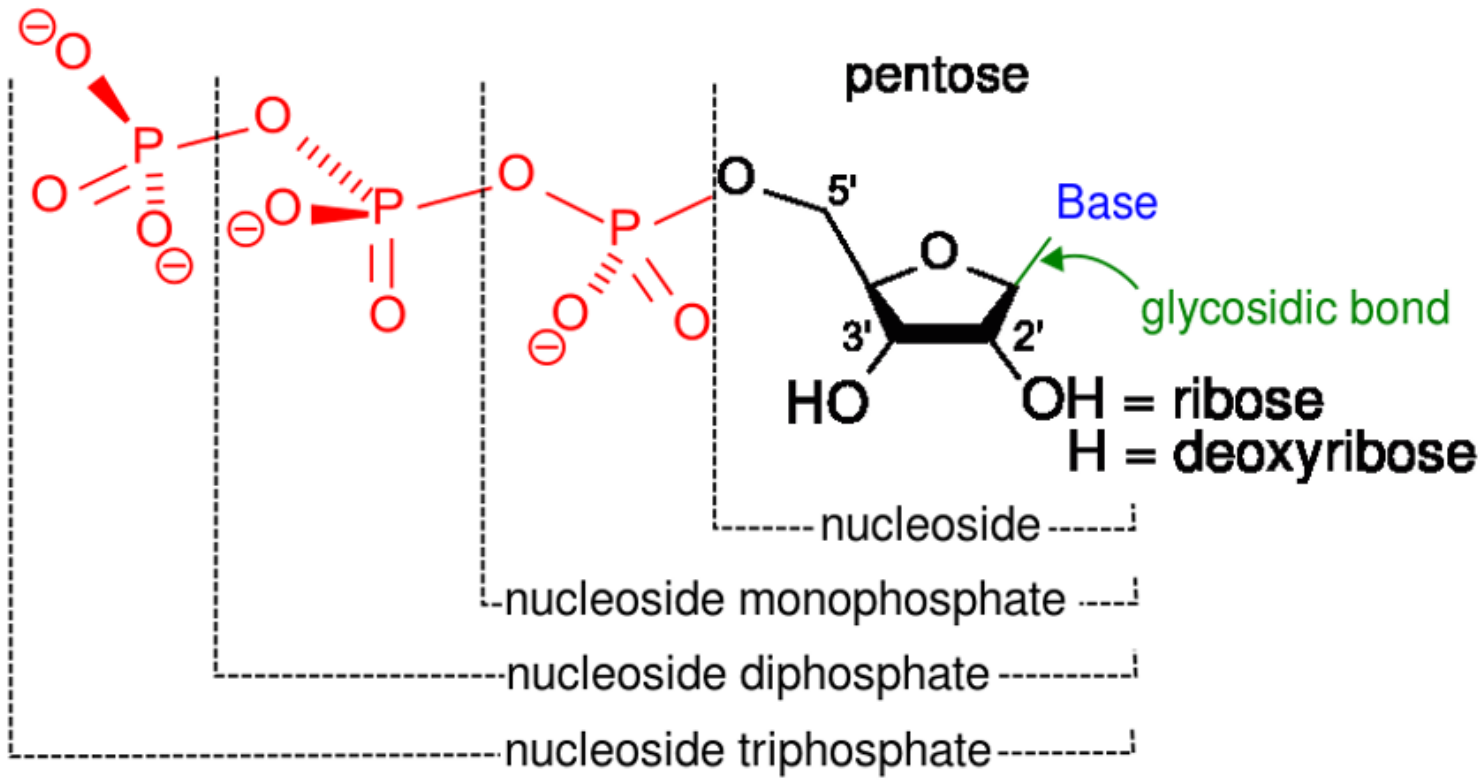
Cont.

- A beta-*N*-glycosidic bond links the carbon one of the pentose sugar and N9 of a purine or N1 of a pyrimidine (e.g., A, G, C, T, U, & I).

- **Nucleotides:** 3 main components: A nitrogenous base, Pentose sugar & Phosphate groups.

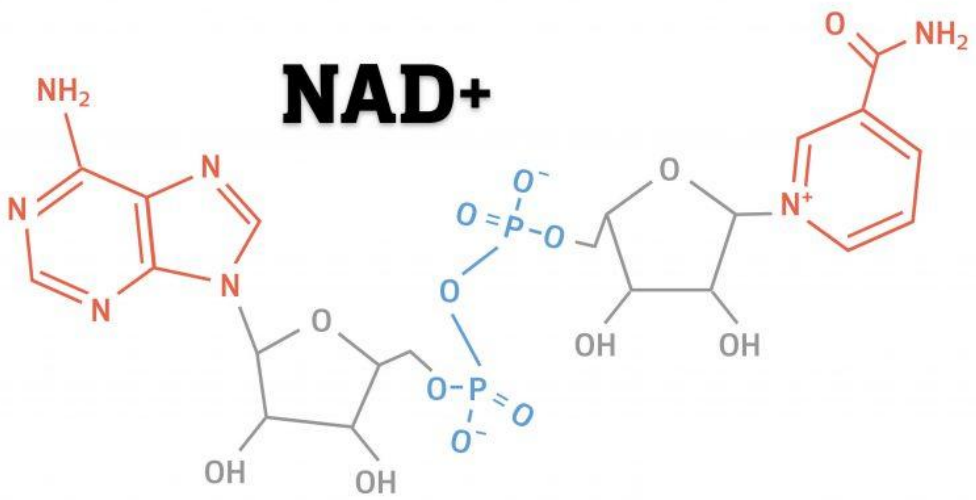
- These molecules form the DNA backbone (e.g., AMP, GMP, CMP)

- **> 1 phosphate groups:** Esterification of the phosphate groups forms the corresponding nucleoside diphosphates and triphosphates (e.g., ATP & ADP.



- Nucleo**S**ide:
- base + **S**ugar

- Nucleo**T**ide:
- base + sugar + phospha**T**e

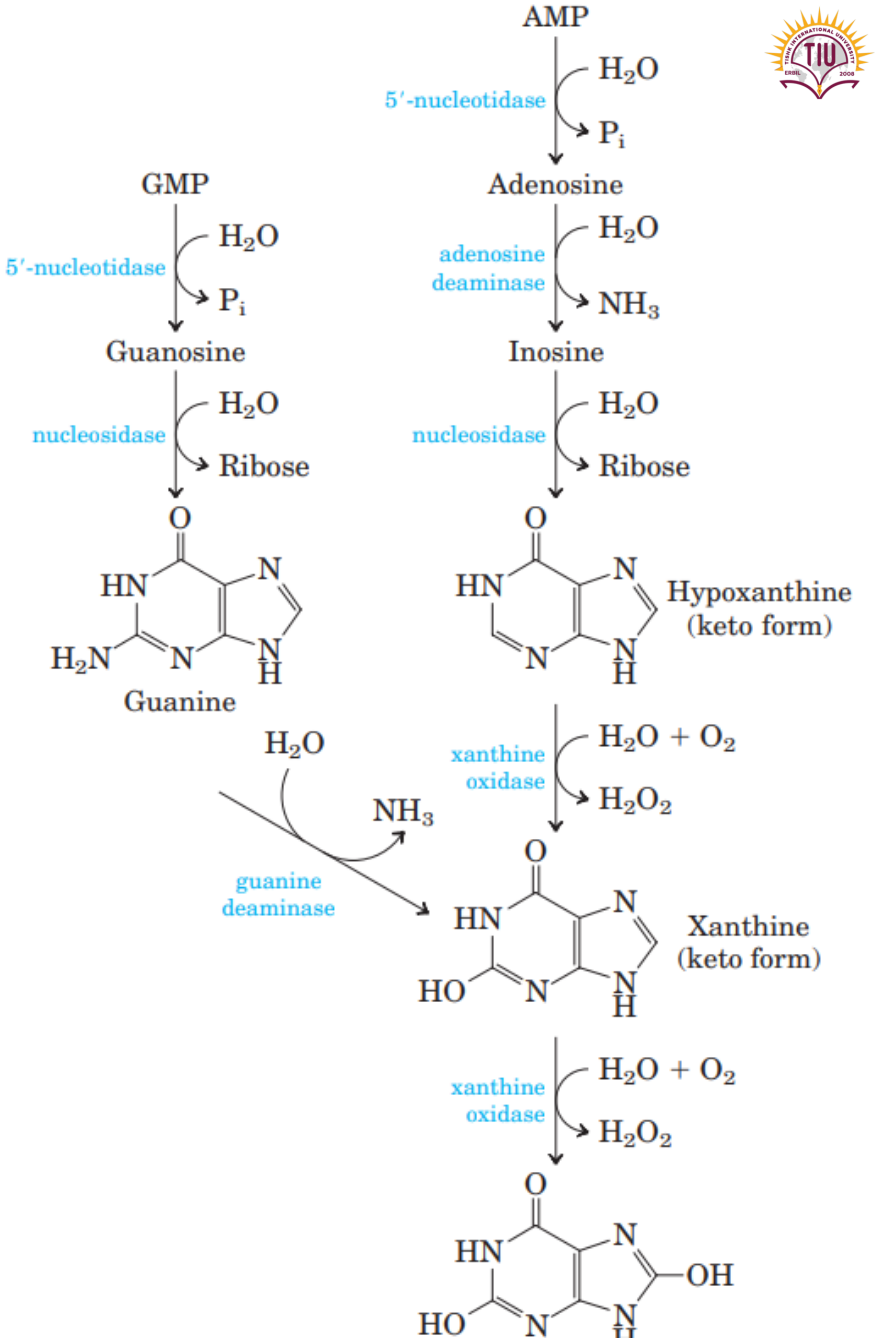


Biomedical importance nucleotides

- The main functions of nucleotides: Form the building blocks of nucleic acids.
- Act as co-substrates and coenzymes in biochemical reactions Involved in cell signaling pathways.
- Also act as intracellular second messengers.
- Provide chemical energy in the form of nucleoside triphosphates such as ATP.

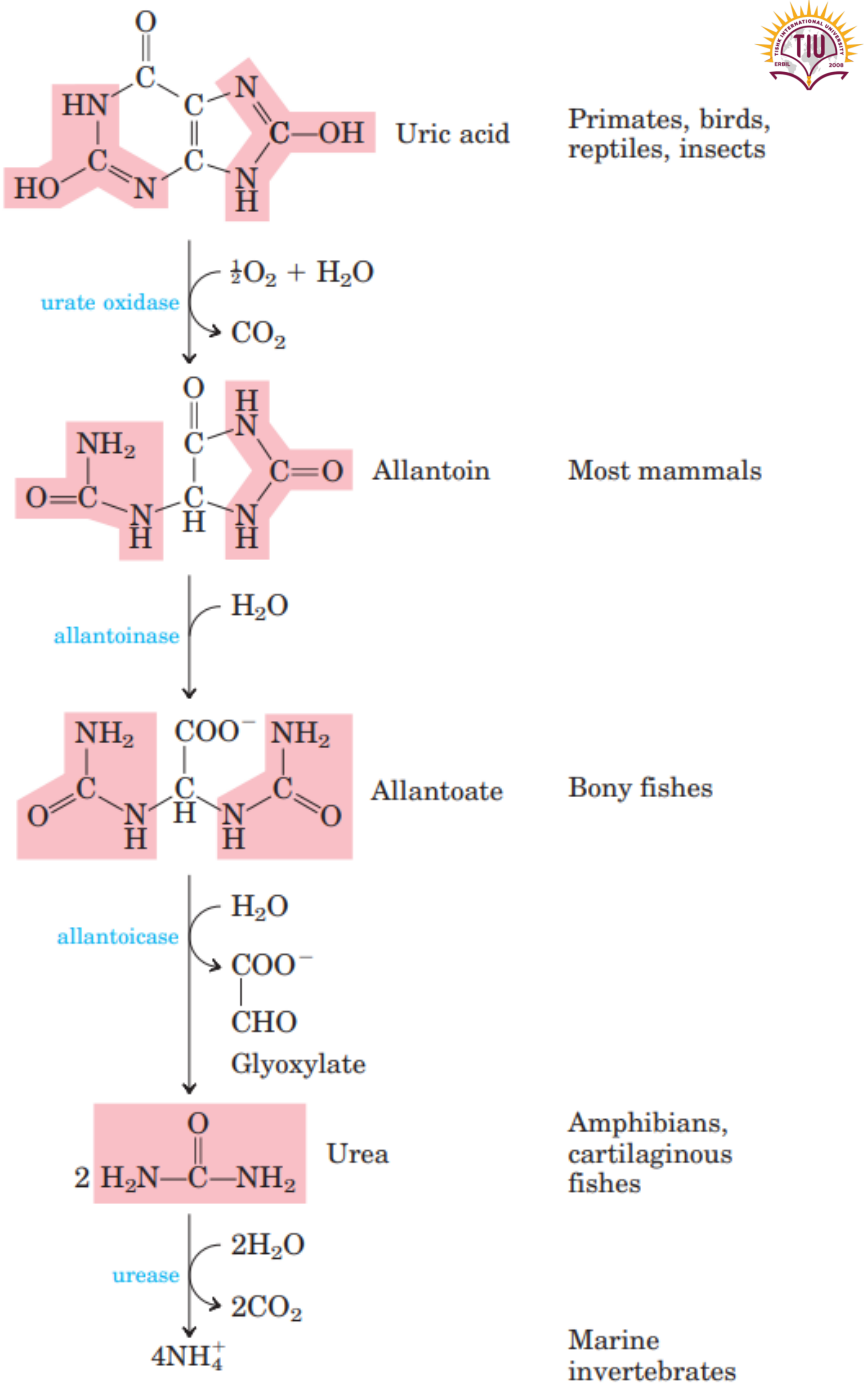
Purine's Degradation

- Purine nucleotides are degraded through a pathway in which they lose their phosphate by the action of **5-nucleotidase** to produce adenosine.
- Adenosine is deaminated to inosine by **adenosine deaminase**, and inosine is hydrolyzed to hypoxanthine (its purine base) and D-ribose by **nucleosidase**.
- Hypoxanthine is further oxidized to xanthine and then uric acid by xanthine oxidase.
- Molecular oxygen is the electron acceptor in this complex reaction.



Excretion of purine products

- Uric acid is the excreted product of purine catabolism in primates, birds, and some other animals.
- A healthy adult human excretes uric acid at a rate of about 0.6 g/24 h.
- The excreted product arises in part from ingested purines and in part from the turnover of the purine nucleotides.
- In most mammals and many other vertebrates, uric acid is further degraded to allantoin by the action of urate oxidase.
- In other organisms the pathway is further extended to urea and ammonium.



Class activities

- Describe the term Nucleic Acid with examples
- Differentiate between Nucleotide and Nucleoside with clear examples
- Outline the biomedical importance of nucleotide
- Enumerate the byproducts of purine degradation.
- Which of the byproducts above is excreted by humans?


Questions
Comments
Feedback

References

- Luch, A. ed., 2012. *Molecular, clinical and environmental toxicology: volume 3: Environmental toxicology* (Vol. 101). Springer Science & Business Media.

- Barile, F.A., 2010. Clinical Toxicology. *Principles and Mechanisms. New York, Informa Healthcare*, *467*.

- Plumlee, K., 2003. *Clinical Veterinary Toxicology-E-Book*. Elsevier Health Sciences.