Unit V, S13 and S14

Synthesis of a commonly used drug molecule-Introduction

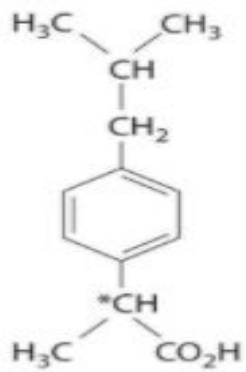
Synthesis of a commonly used drug molecule-Examples

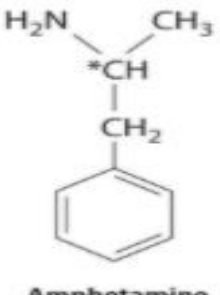
Dt. 12/01/2021

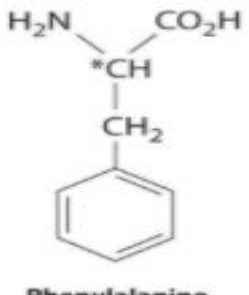
Introduction to commonly used drug molecules and the drug action

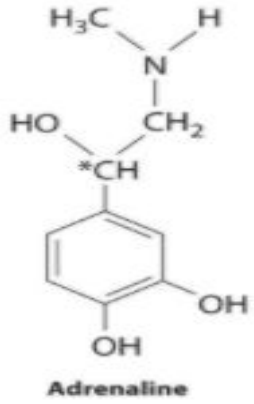
Introduction to drugs

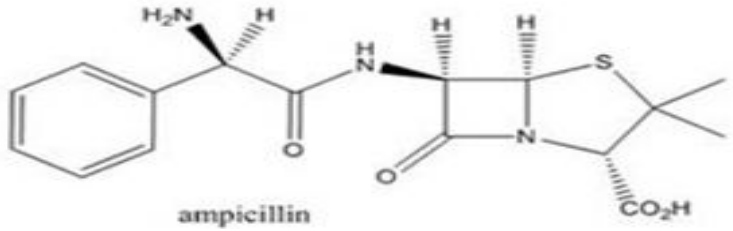
Drug is a chemical substance used in the treatment, cure, prevention, or diagnosis of disease or used to otherwise enhance physical or mental well-being.

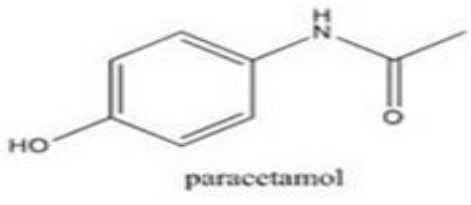




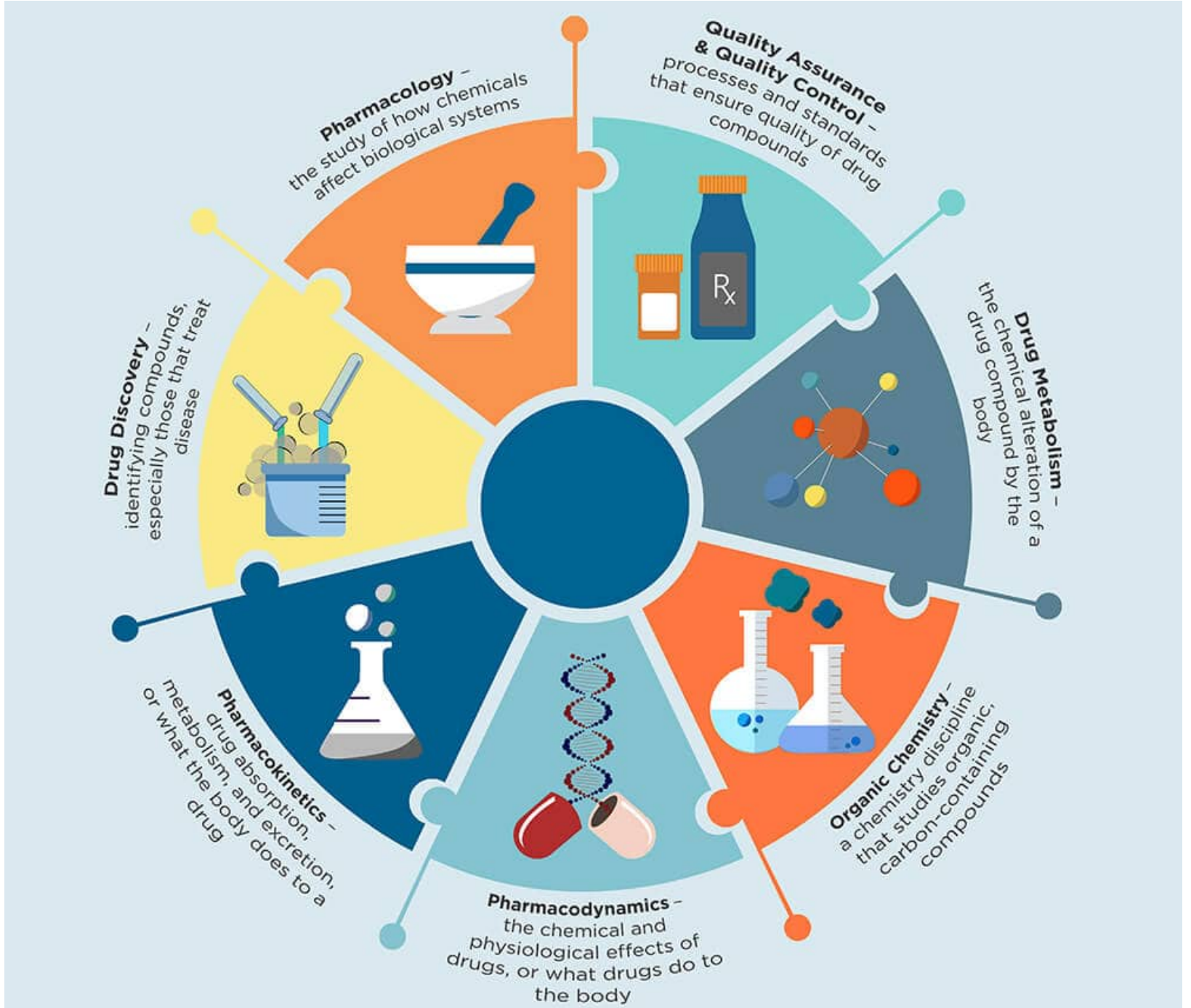








Drugs are mainly small organic/inorganic molecules both natural and synthetic. Compounds in clinical use are primarily small organic compounds. Organometallic compounds, biopharmaceuticals, and inorganic compounds are also used in medicine as therapeutics.


Pharmacology – the study of how chemicals affect biological systems
Quality Assurance & Quality Control – processes and standards that ensure quality of drug compounds
Drug Metabolism – the chemical alteration of a drug compound by the body
Organic Chemistry – a chemistry discipline that studies organic, carbon-containing compounds
Pharmacodynamics – the chemical and physiological effects of drugs, or what drugs do to the body
Pharmacokinetics – drug absorption, metabolism, and excretion, or what the body does to a drug
Drug Discovery – identifying compounds, especially those that treat disease
Rx

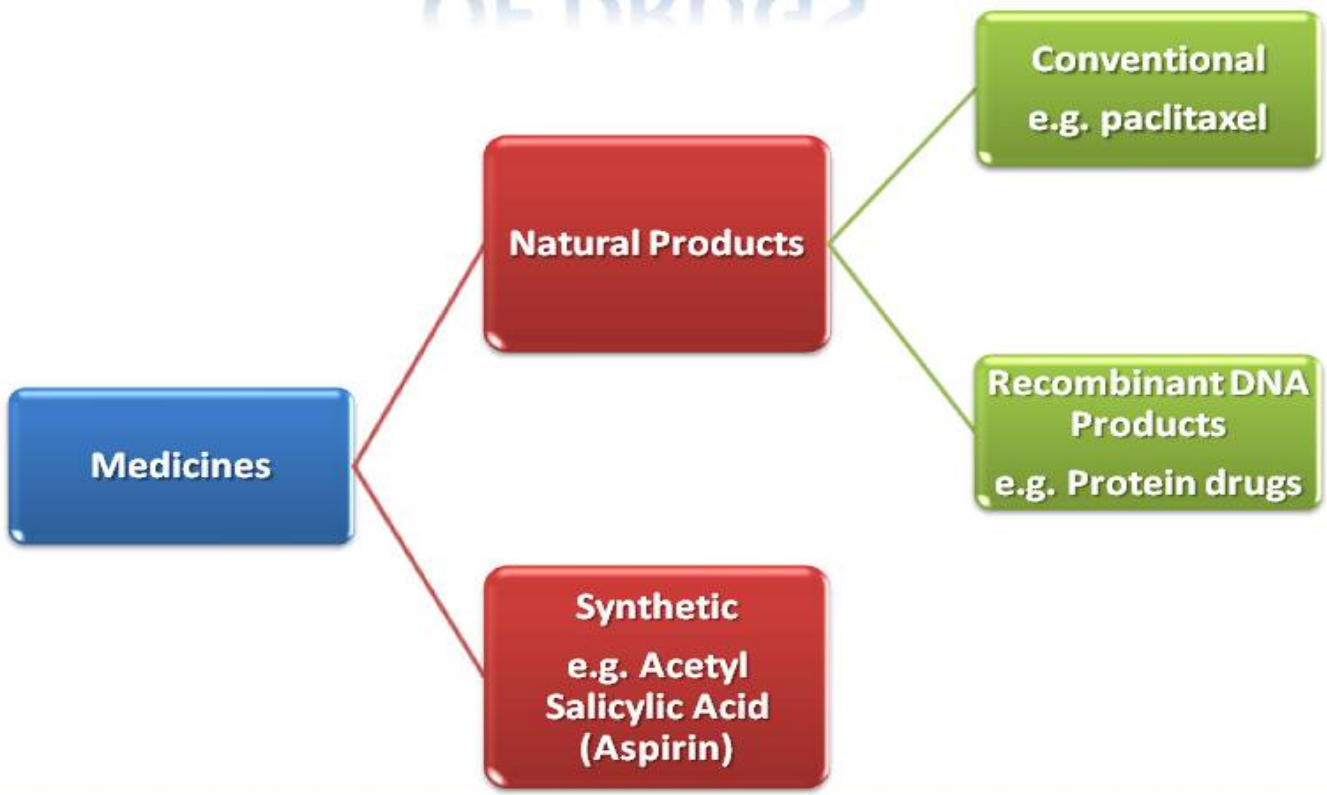
Phases of drug action

- The Pharmaceutical Phase
- The Pharmacokinetic Phase
- The Pharmacodynamic Phase

- **Pharmacokinetics refers to the study of the time course of drug absorption, distribution, metabolism, and excretion.**

- **Pharmacodynamics is the study of what the drug does to the body**

HIERARCHICAL CLASSIFICATION OF DRUGS

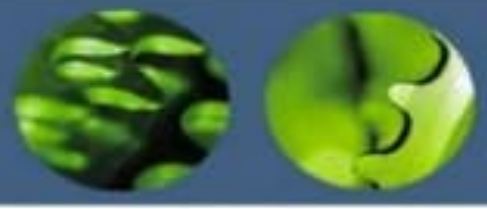


Drug Classification

- Drugs are broken down into different classifications based on how they effect the body.
  - Narcotics
  - Depressants
  - Stimulants
  - Hallucinogens
  - Inhalants
  - Marijuana

Classifications of Drugs

- Analgesics-drugs that relieve pain and raise the pain threshold
- Anesthetics- drugs that decreases feeling sensation; numbing
- Anticonvulsants-drugs that inhibit seizures
- Stimulants-drugs that excite the functional activity of an organ
- Tranquilizers- drugs that sedate/quiet an anxious patient



Drug Classifications

1. Anti-Hemorrhoid Drugs
2. Topical Antibiotics
3. Cough-Suppressants
4. Anti-acne Drugs
5. Non-steroidal Anti-inflammatory Drugs
6. Antiseptics
7. Analgesics
8. Salicylates

Drug targets

Drugs **bind** to their targets in regions known as **binding sites**. Most drugs interact with their targets through **intermolecular bonds**. However, **some drugs form covalent bonds** with their targets (e.g., alkylating agents). **Covalent bonds are typically strong**, requiring around 80 – 440 kJ mol^{-1} to break these bonds.

The main drug targets in the body are **macromolecules** (large molecules) with molecular weights far greater than small drug molecules.

- **Nucleic Acids**
  - **Deoxyribonucleic acid (DNA)**
  - **Ribonucleic acid (RNA)**
- **Proteins (main)**
  - **Transport proteins**
  - **Enzymes**
  - **Structural Proteins**
  - **Receptors**

Drug target interaction- example

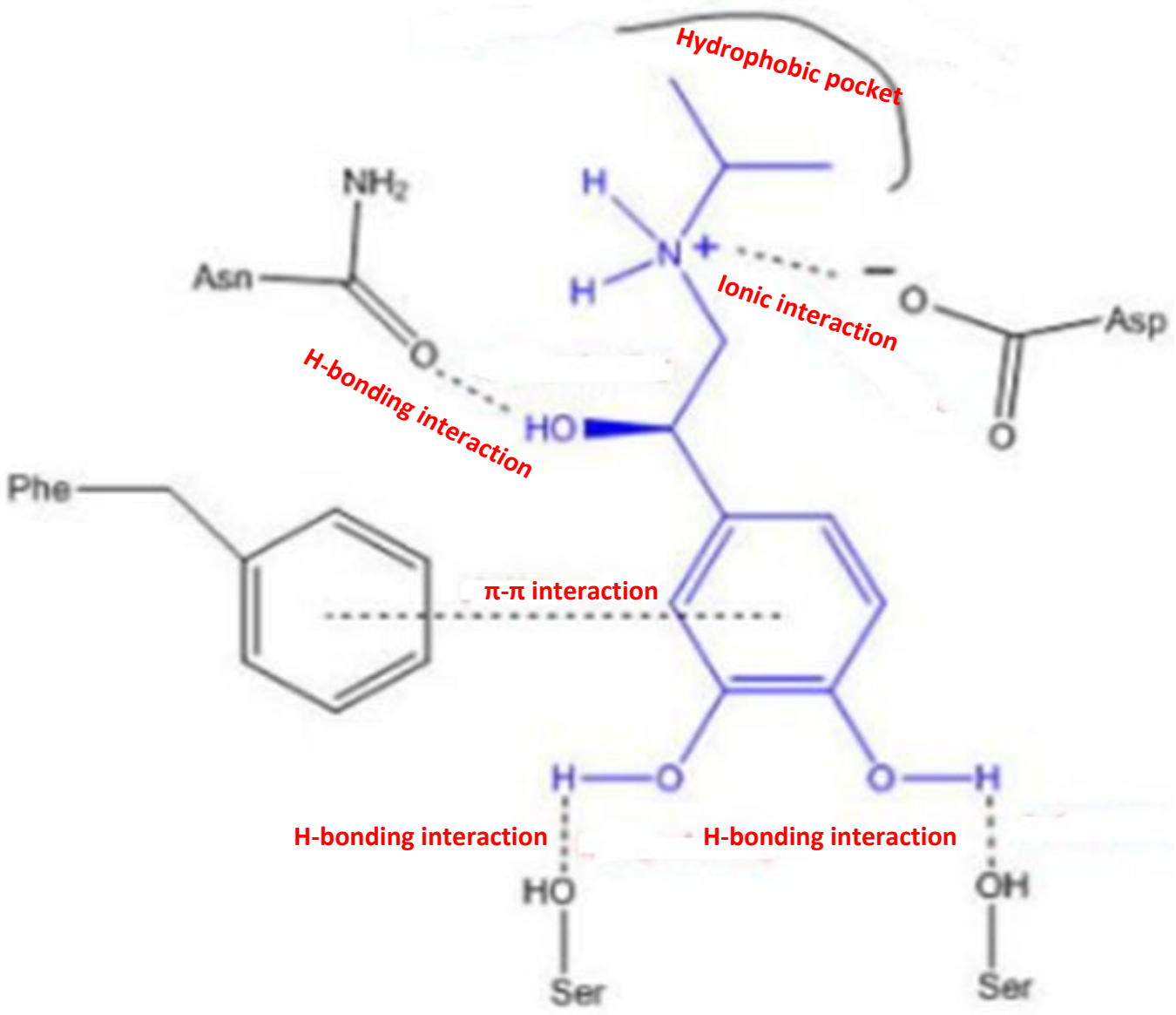


Figure: Interactions of the cardiac stimulant and bronchodilator isoprenaline with the β-adrenoceptor binding site. Ionic interactions, hydrogen bonding, hydrophobic interactions, and π- π interactions are shown. Isoprenaline's affinity for the β-adrenoceptors is thought to be due to the presence of a hydrophobic pocket in β-adrenoceptors which can accommodate the bulky isopropyl group.

Aspects of drug design

The drug design aspect of medicinal chemistry plays an important role in optimising drug-target interactions

Drug design is also concerned with

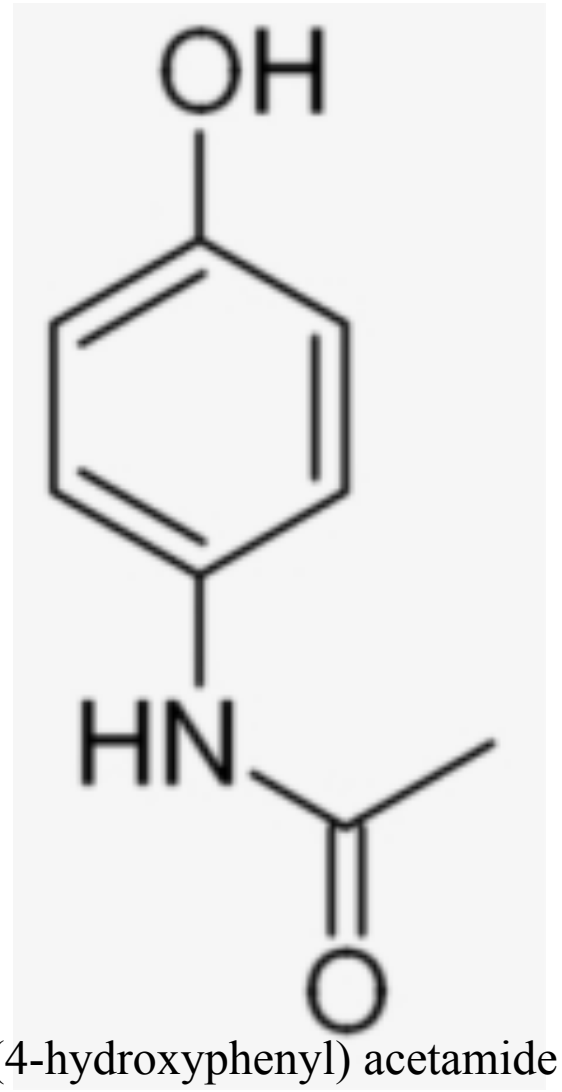
- Improving a drug's pharmacokinetic profile
- Improving specificity

Drug synthesis

Paracetamol
(Acetaminophen)

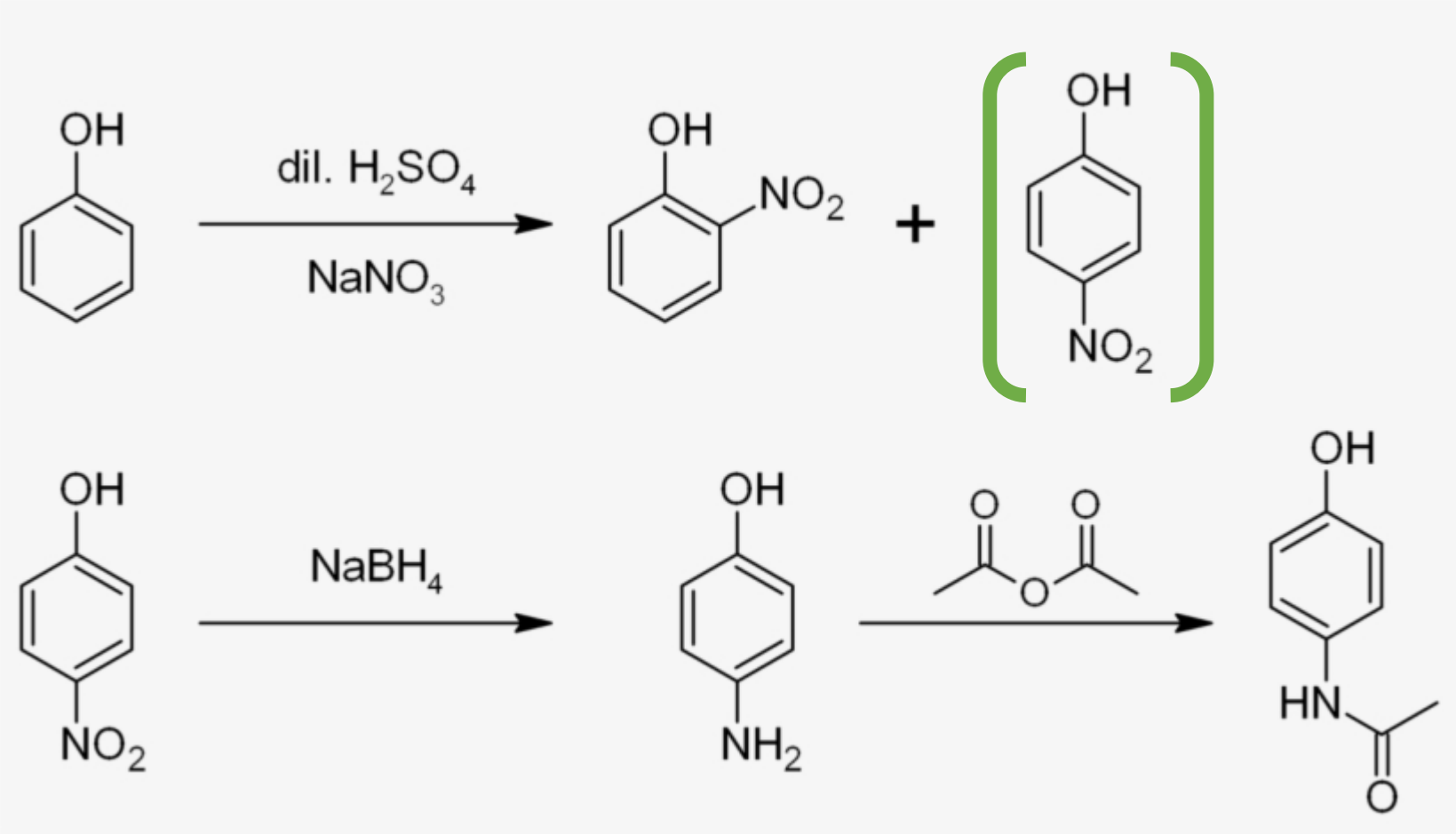
Antipyretic

Analgesic



N-(4-hydroxyphenyl) acetamide

Synthesis of Paracetamol



Uses of paracetamol

PARACETAMOL USES

1. Fever

It is widely prescribed to relieve fever in person of all ages. Paracetamol is prescribed in children if temperature is greater than 38. 5 Celsius or 101.3 Fahrenheit.

2. Pain

It is also prescribed to relieve mild to moderate pain.

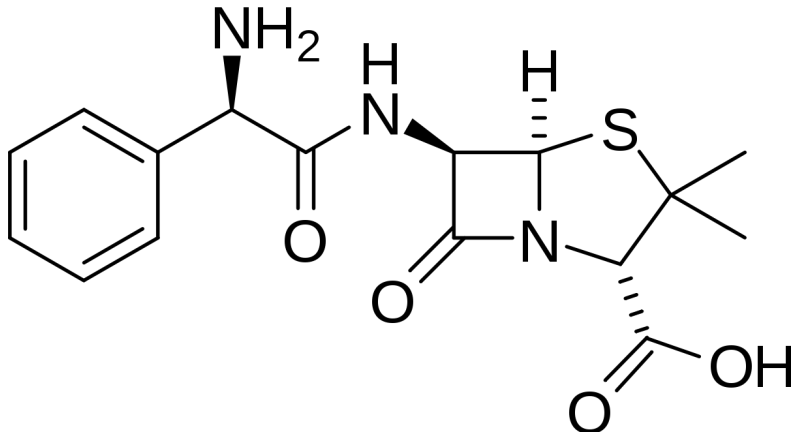
3. Osteoarthritis

Some studies state that paracetamol is also used to treat arthritis pain of knee, hand or hips.

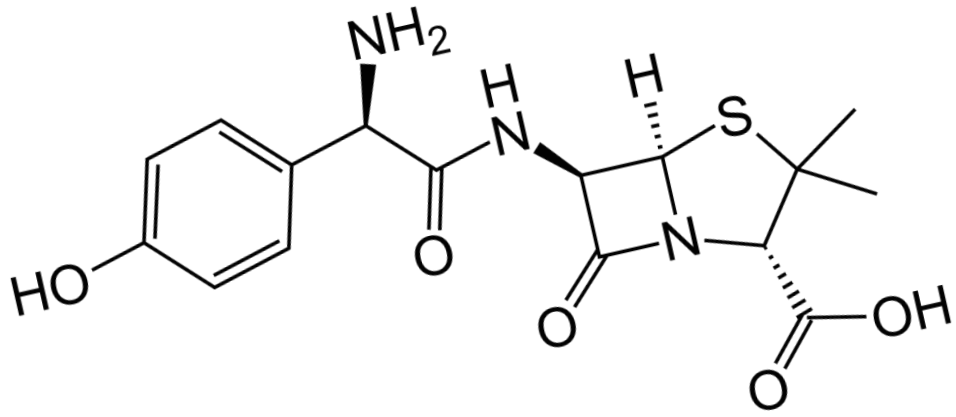
4. Lower Back Pain

It is first line treatment of lower back pain.

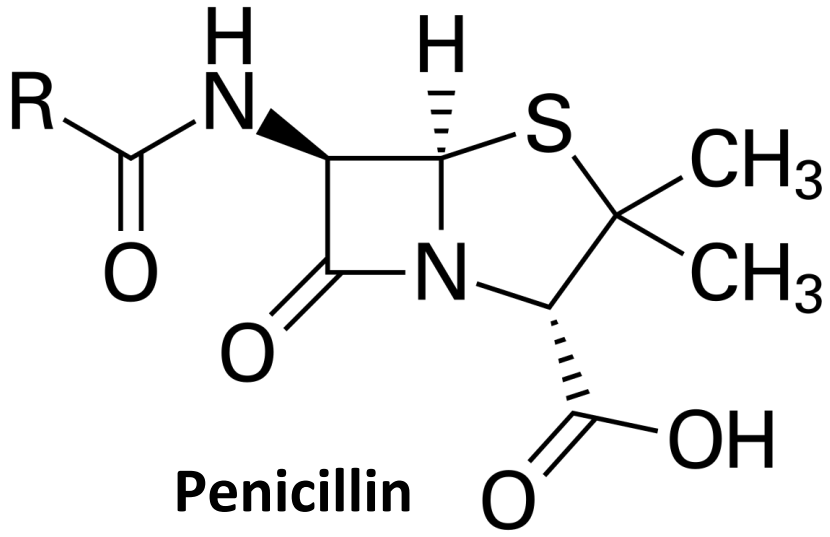
Some antibiotic drug molecules



Ampicillin



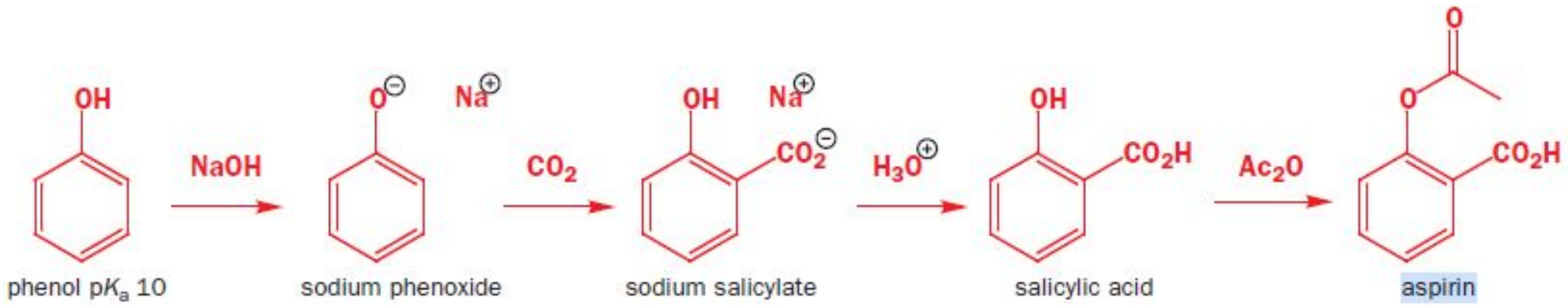
Amoxycillin



Penicillin

Synthesis of Aspirin and its uses

(Acetyl salicylic acid)



2-Acetoxybenzoic acid

Uses Of Aspirin

- It is used to treat pain and fever.
- Aspirin is also used long-term, at low doses, to help prevent heart attacks, strokes, and blood clot formation in people at high risk of developing blood clots.
- Aspirin may be effective at preventing certain types of cancer, particularly colorectal cancer.
- Over-the-counter pain relief, especially for headaches.

Uses of Aspirin

- As analgesic (300 to 600 mg during 6 to 8 h) for headache, backache, pulled muscle, toothache, neuralgias.
- As antipyretic in fever of any origin in the same doses as for analglesia. However, *paracetamol and metamizole are safer*, and generally preferred.
- Acute rheumatic fever. *Aspirin is the first drug of choice. Other drugs substitute Aspirin only when it fails or in severe cases.* Antirheumatic doses are 75 to 100 mg/kg/24 h (resp. 4–6 g daily) in the first weeks.
- Rheumatoid arthritis. Aspirin a dose of 3 to 5 g/24 h *after meal* is effective in most cases. Since large doses of Aspirin are poorly tolerated for a long time, the new NSAIDs (diclofenac, ibuprofen, etc.) in depot form are preferred.

Side Effects of Aspirin

- Aspirin can irritate the stomach lining which may lead to ulcers
- If aspirin is used over long periods of time, it may lead to problems with blood clotting
- An overdose on aspirin, such as the case with some arthritis sufferers, may lead to dizziness, ringing in the ears, gastrointestinal problems, mental confusion, and bleeding.
- Some people are allergic to aspirin leading to bronchial asthma
- In children under 12 Aspirin has been linked to Reye's syndrome