Functional groups at a glance

The few atoms that decide how a molecule behaves. Learn to spot them, and you can read almost any medicine.

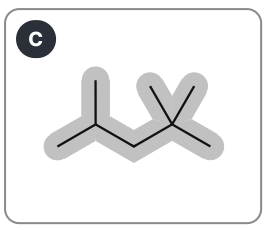
C Carbon skeleton · O Oxygen · N Nitrogen · S Sulfur · X Halogens

The grey glow marks the group in each drawing.

Chem2Cure
Institute for Chemical Research and Therapeutics

Alkane

C



Isooctane, the petrol benchmark

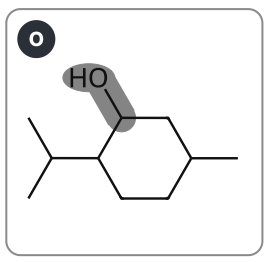
C–C, C–H · name: -ane

SPOT IT
Only C–C and C–H single bonds.

WHY IT MATTERS
Greasy and unreactive. Adds bulk and helps a molecule dissolve in fat.

Alcohol

O



Menthol, mint

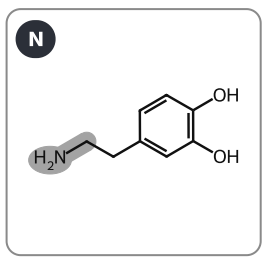
R–OH · name: -ol

SPOT IT
OH on a carbon that has only single bonds.

WHY IT MATTERS
Gives and takes hydrogen bonds, so it helps a molecule dissolve in water.

Amine

N



Dopamine, a neurotransmitter

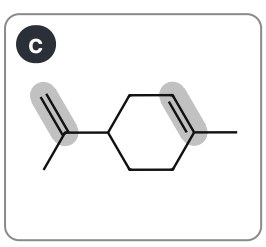
R–NH₂ · name: -amine

SPOT IT
N with only single bonds to carbon or hydrogen.

WHY IT MATTERS
Basic. It picks up H^+, so it is often charged in the body. Very common in drugs.

Alkene

C



Limonene, citrus peel

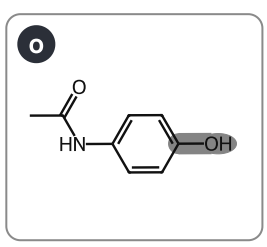
C=C · name: -ene

SPOT IT
A carbon–carbon double bond.

WHY IT MATTERS
Flat and reactive. It can turn into a single bond by taking on new atoms.

Phenol

O



Paracetamol, fever and pain

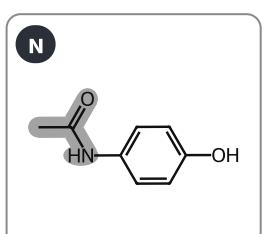
Ar–OH · name: -phenol

SPOT IT
OH sitting directly on an aromatic ring.

WHY IT MATTERS
More acidic than an alcohol, and easily oxidised.

Amide

N



Paracetamol

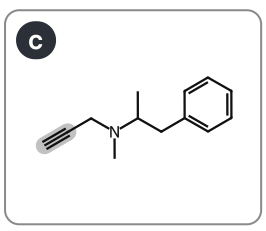
R–CO–NH–R · name: -amide

SPOT IT
A C=O attached straight to a nitrogen.

WHY IT MATTERS
Flat, stable and not basic. It is the link that joins amino acids into proteins.

Alkyne

C



Selegiline, Parkinson's disease

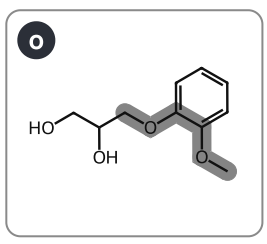
C≡C · name: -yne

SPOT IT
A carbon–carbon triple bond.

WHY IT MATTERS
Straight and rigid. In selegiline it helps the drug lock on to its target enzyme.

Ether

O



Guaifenesin, cough medicine

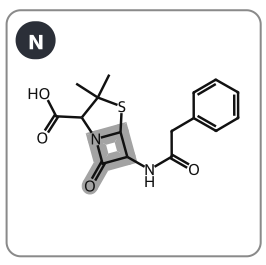
R–O–R · name: -oxy

SPOT IT
Oxygen between two carbons.

WHY IT MATTERS
Takes hydrogen bonds but cannot give them. Stable, so a common link.

β-Lactam

N



Penicillin G, antibiotic

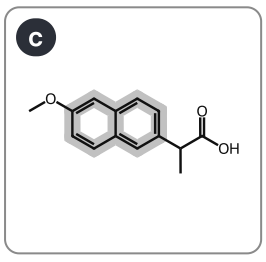
4-ring amide · name: -lactam

SPOT IT
An amide in a strained four-membered ring.

WHY IT MATTERS
Strain makes it reactive. It blocks enzymes that bacteria need to build cell walls.

Aromatic ring

C



Naproxen, a painkiller

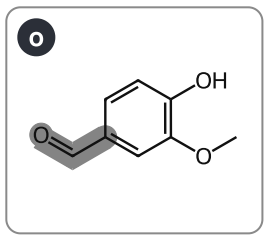
benzene ring · name: phenyl-

SPOT IT
A flat ring whose electrons are shared all the way round.

WHY IT MATTERS
Very stable and flat. It sits in flat pockets of proteins and adds greasiness.

Aldehyde

O



Vanillin, vanilla

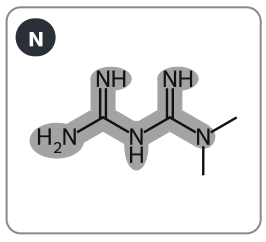
R–CHO · name: -al

SPOT IT
C=O at the end of a chain, with an H on that carbon.

WHY IT MATTERS
Reactive. Oxidises easily to an acid and reacts with amines.

Guanidine

N



Metformin, diabetes

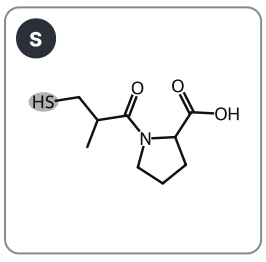
N–C(=N)–N · name: -guanidine

SPOT IT
A carbon joined to three nitrogens.

WHY IT MATTERS
A very strong base, so charged in the body. Also in the amino acid arginine.

Thiol

S



Captopril, blood pressure

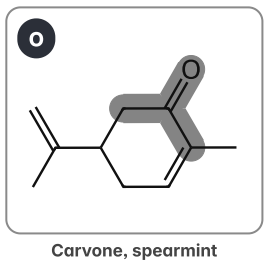
R–SH · name: -thiol

SPOT IT
Sulfur with an H: an alcohol with S in place of O.

WHY IT MATTERS
Smelly, and it grips metals. Captopril uses it to hold on to the zinc in its target.

Ketone

O



Carvone, spearmint

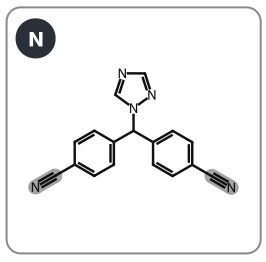
R–CO–R · name: -one

SPOT IT
C=O in the middle of a chain, between two carbons.

WHY IT MATTERS
Polar and takes hydrogen bonds. Less reactive than an aldehyde.

Nitrile

N



Letrozole, breast cancer

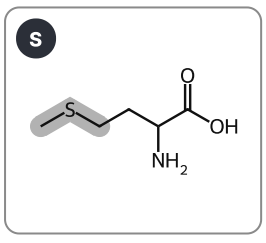
R–C≡N · name: -nitrile

SPOT IT
A carbon triple-bonded to a nitrogen.

WHY IT MATTERS
Small, polar and straight. A neat hydrogen-bond acceptor in many drugs.

Sulfide

S



Methionine, an amino acid

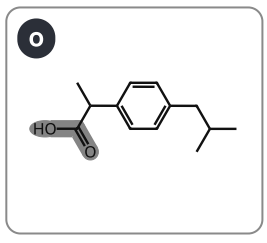
R–S–R · name: sulfide

SPOT IT
Sulfur between two carbons.

WHY IT MATTERS
Can be oxidised to a sulfoxide or a sulfone. Found in the amino acid methionine.

Carboxylic acid

O



Ibuprofen, pain and fever

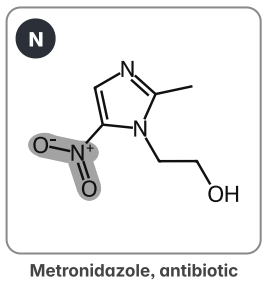
R–COOH · name: -oic acid

SPOT IT
A C=O and an OH on the same carbon.

WHY IT MATTERS
Acidic. At body pH it loses its H and is charged, which helps it dissolve.

Nitro

N



Metronidazole, antibiotic

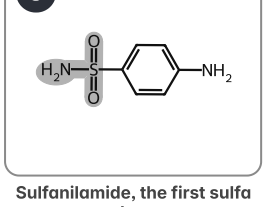
R–NO₂ · name: nitro-

SPOT IT
N bonded to two oxygens, one of them charged.

WHY IT MATTERS
Pulls electrons. Microbes turn it into a reactive form: how metronidazole works, and a safety flag.

Sulfonamide

S



Sulfanilamide, the first sulfa drug

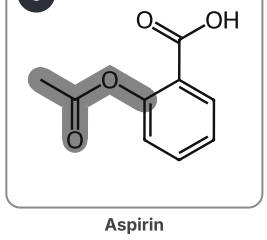
R–SO₂–N · name: -sulfonamide

SPOT IT
S with two double-bonded O and one N.

WHY IT MATTERS
Weakly acidic NH. Sulfa drugs were among the first antibiotics.

Ester

O



Aspirin

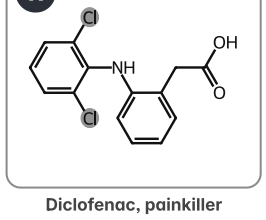
R–COO–R · name: -oate

SPOT IT
A C=O next to an O that joins two carbons.

WHY IT MATTERS
Fruity smells. Water and enzymes cut it, so it is often used in prodrugs.

Halogen

X

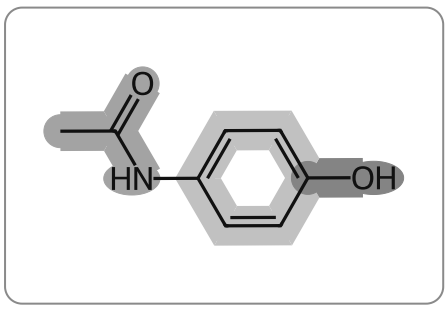


Diclofenac, painkiller

R–X (F, Cl, Br, I) · name: halo-

SPOT IT
F, Cl, Br or I on a carbon.

WHY IT MATTERS
Adds greasiness and weight. A C–F bond is so strong it can slow a drug's breakdown.



SPOT THEM IN ONE MEDICINE

Paracetamol has three groups from three families.

Find the glow on each card, then find it here. Real drugs are just a few of these groups joined together.

Aromatic ring · Phenol · Amide

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