Chapter 24 From Petroleum to Pharmaceuticals

24.1 Petroleum Refining and the Hydrocarbons

24.2 Functional Groups and Organic Synthesis

24.3 Pesticides and Pharmaceuticals

Physical Properties of Alkanes and Cycloalkanes

Why do molecules tend to stick together?

Boiling Points

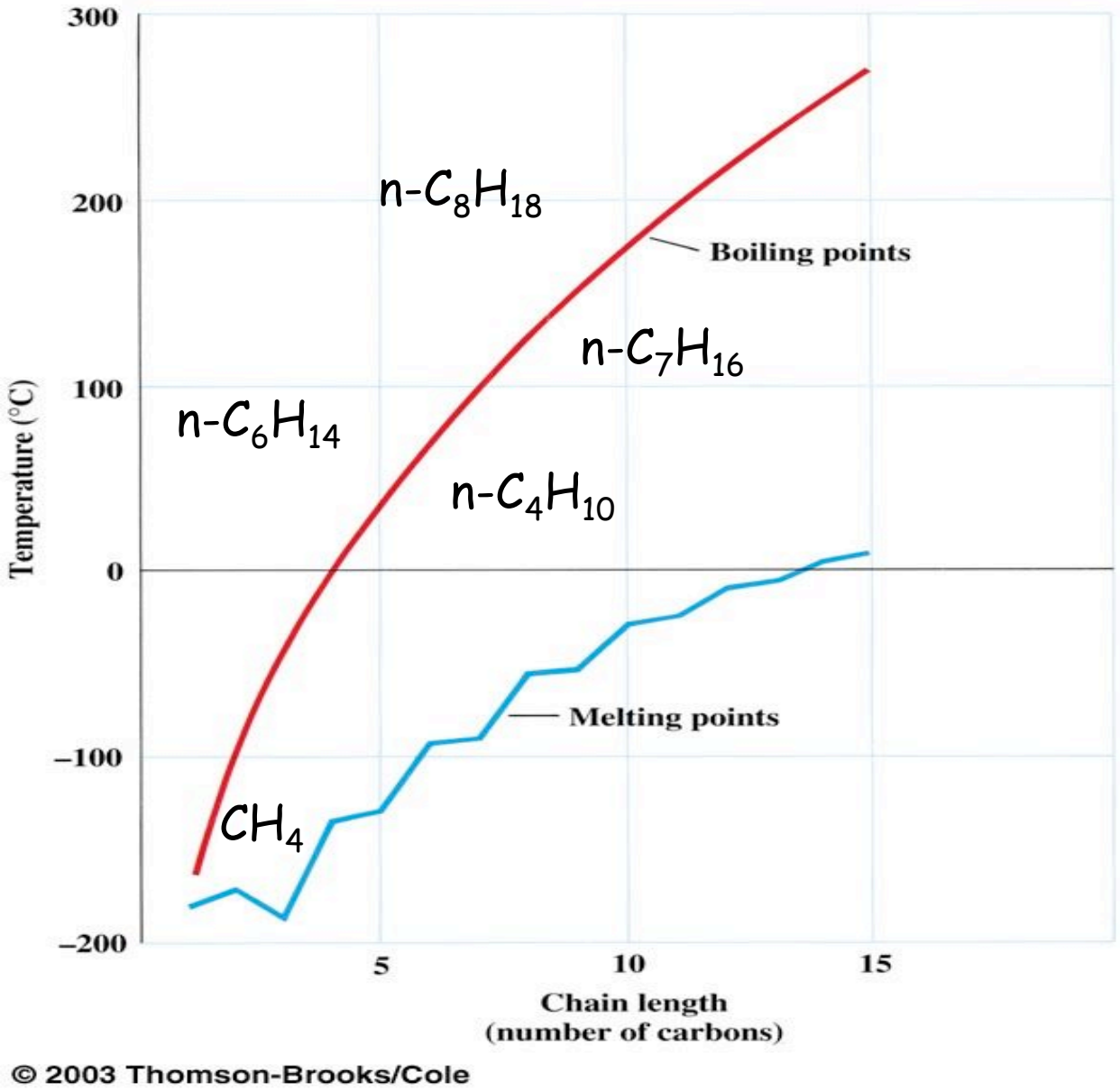
increase with increasing number of carbons

- more atoms, more electrons, more opportunities for induced dipole-induced dipole forces

decrease with chain branching

- branched molecules are more compact with smaller surface area—fewer points of contact with other molecules

Boiling points and melting points of n-alkanes



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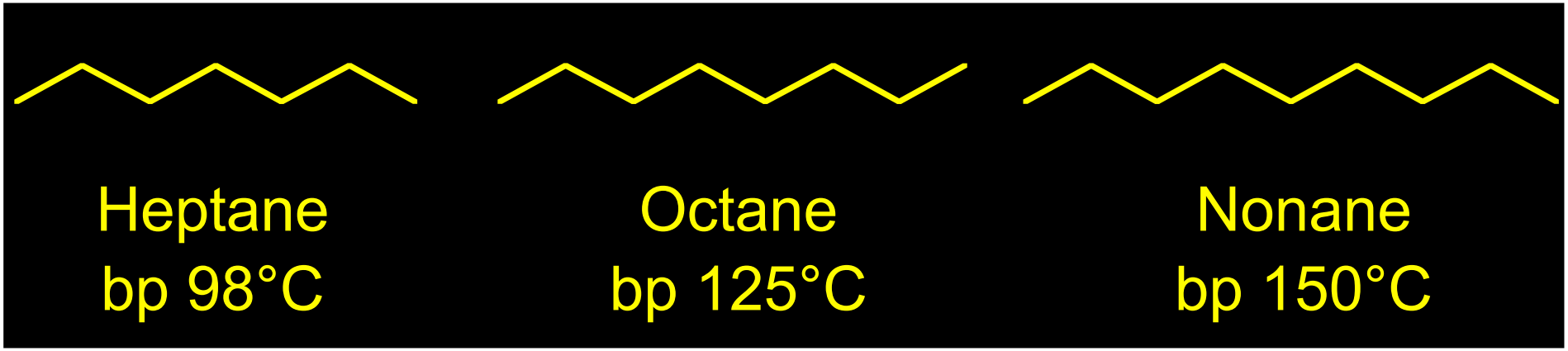
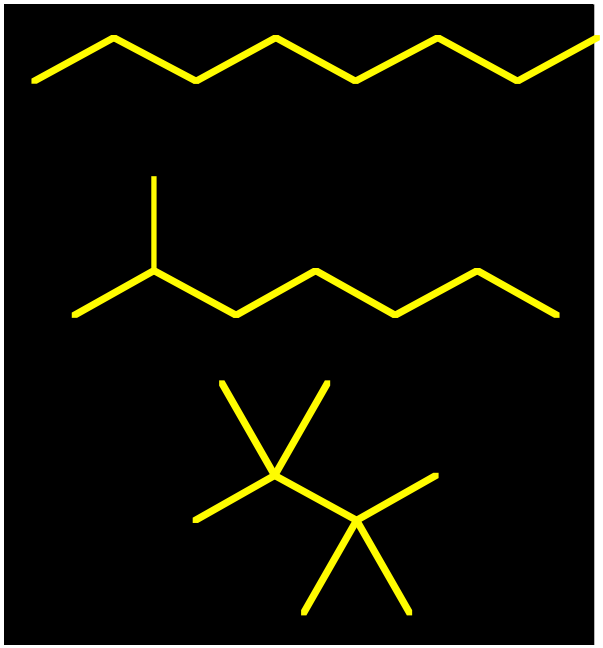


Boiling Points

decrease with chain branching (WHY?)

branched molecules are more compact with smaller surface area—fewer points of contact with other molecules



n-octane: bp 125°C

2-Methylheptane: bp 118°C

2,2,3,3-Tetramethylbutane: bp 107°C

Boiling Points of Alkanes

governed by strength of intermolecular attractive forces

alkanes are nonpolar, so dipole-dipole and dipole-induced dipole forces are absent

only forces of intermolecular attraction are induced dipole-induced dipole forces

Induced dipole-Induced dipole attractive forces

two nonpolar molecules

center of positive charge and center of negative charge coincide in each

Induced dipole-Induced dipole attractive forces

movement of electrons creates an instantaneous dipole in one molecule (left)

Induced dipole-Induced dipole attractive forces

temporary dipole in one molecule (left) induces a complementary dipole in other molecule (right)

Induced dipole-Induced dipole attractive forces

temporary dipole in one molecule (left) induces a complementary dipole in other molecule (right)

Induced dipole-Induced dipole attractive forces

the result is a small attractive force between the two molecules

Induced dipole-Induced dipole attractive forces

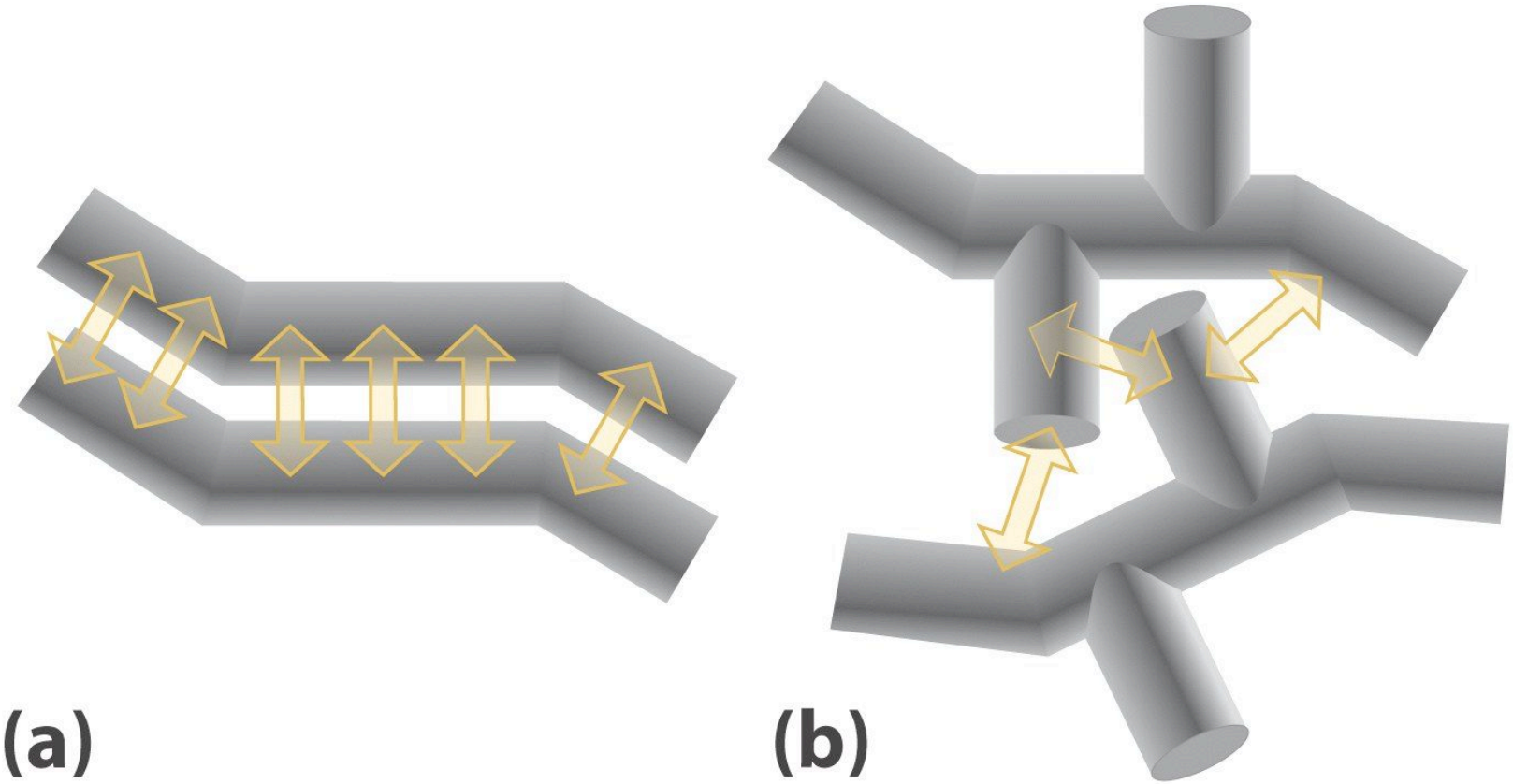
the result is a small attractive force between the two molecules

Straight chain hydrocarbon

Lots of intermolecular contacts

Branched hydrocarbon

Fewer intermolecular contacts



Small organic molecules: required to sustain life and health

Life: food (pesticides and herbicides)

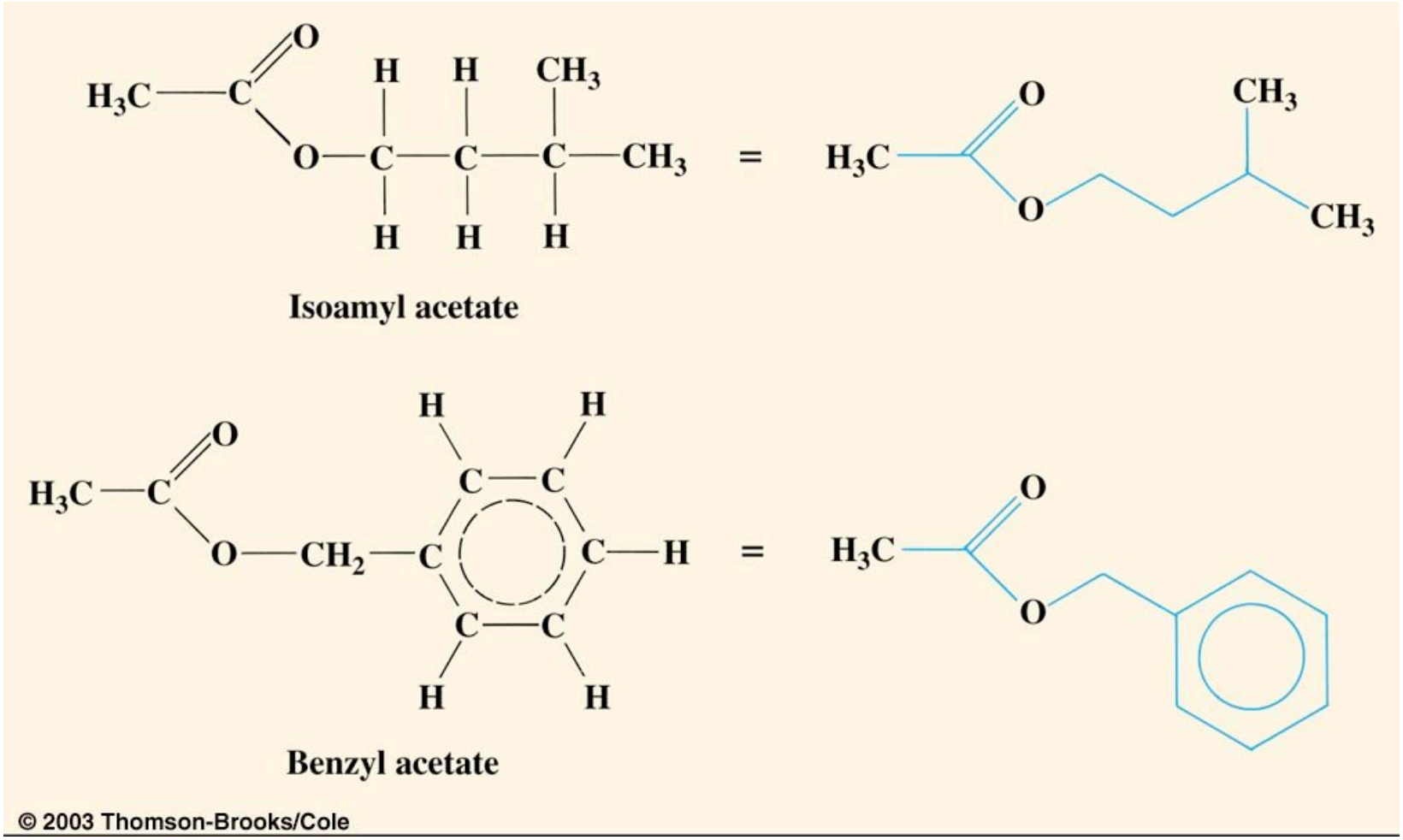
Health: disease and pain control (pharmaceuticals)

Large organic molecules: Polymers (many "mers" or repeating units)

Biomolecules: the blue print (DNA) and the machinery (proteins and sugars) of life

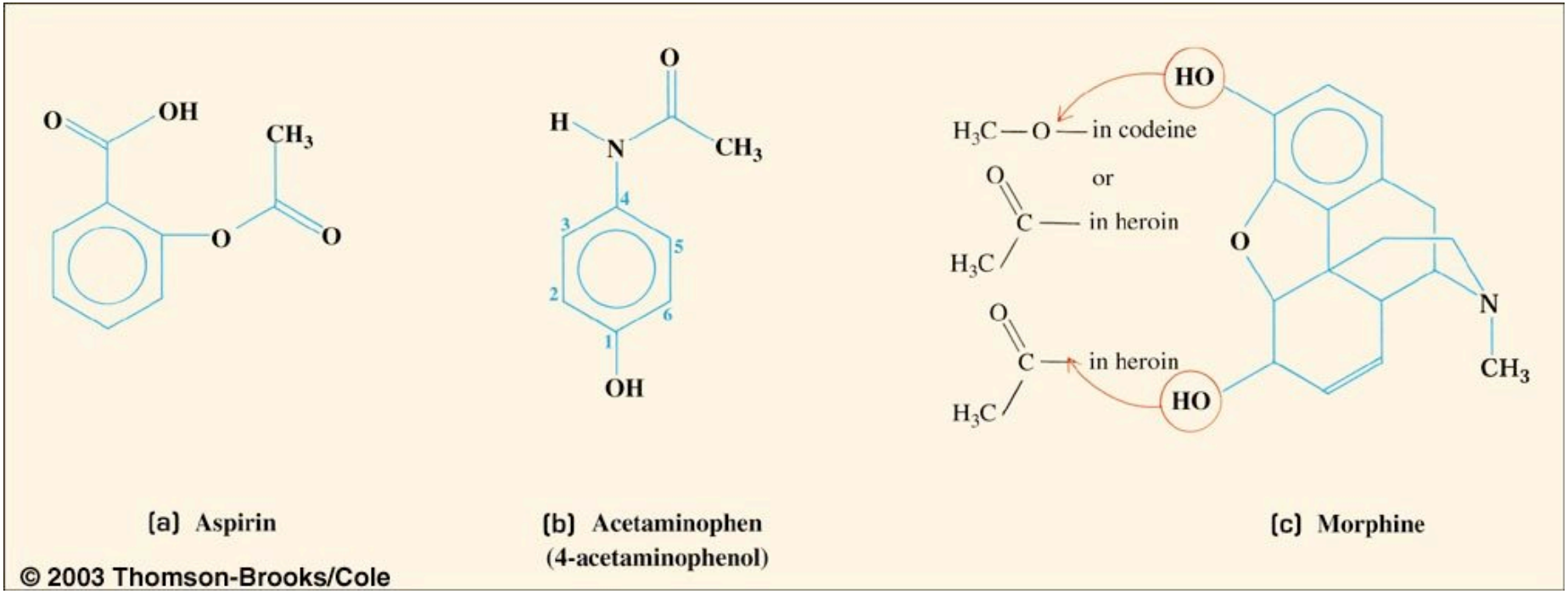
Organic short hand for structures

Note hydrocarbon skeleton, recognize functional groups



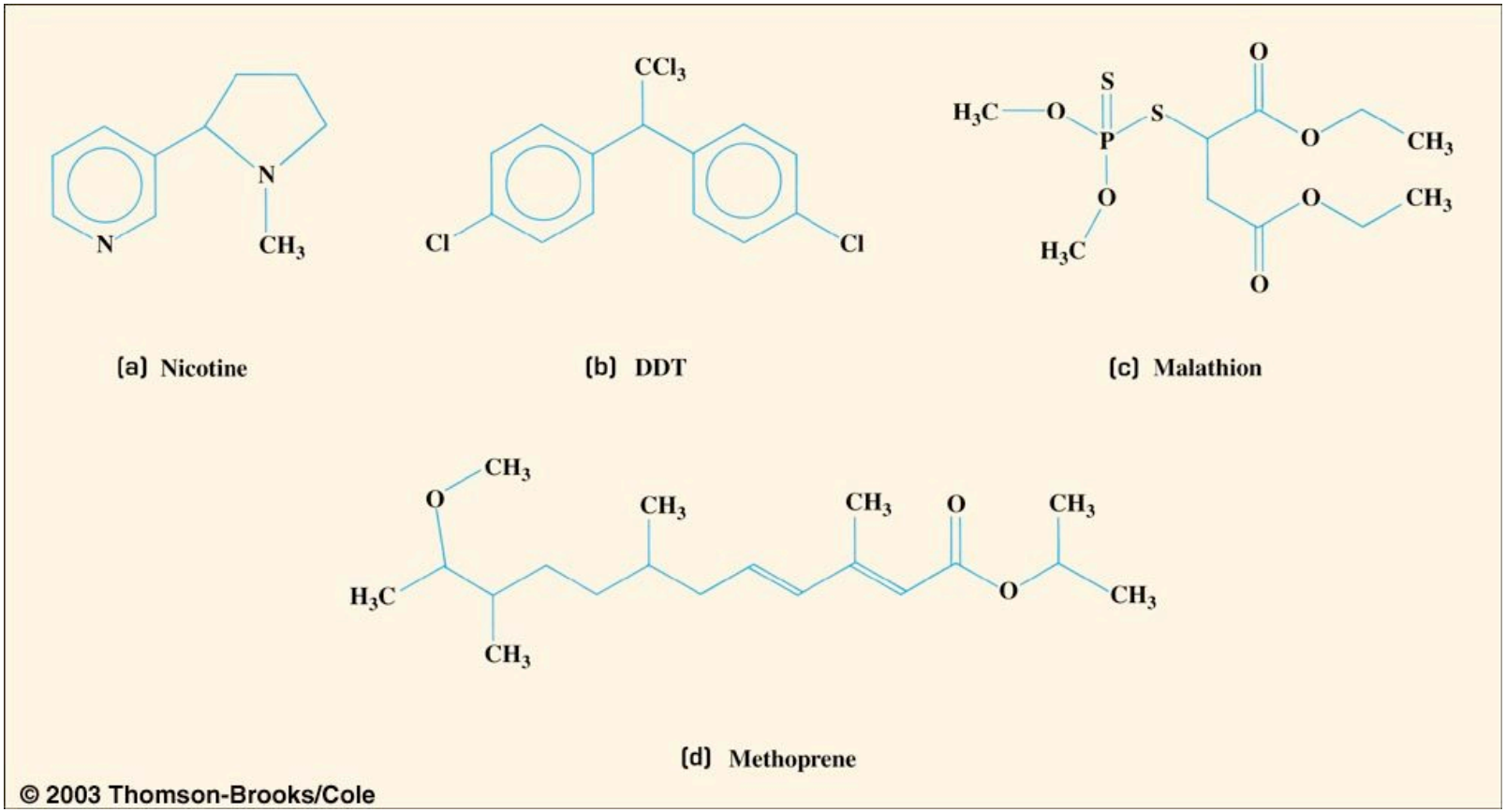
Structure of some small molecule analgesics

Molecular shape and functional groups determine the onset of pain and the molecular structure for its relief



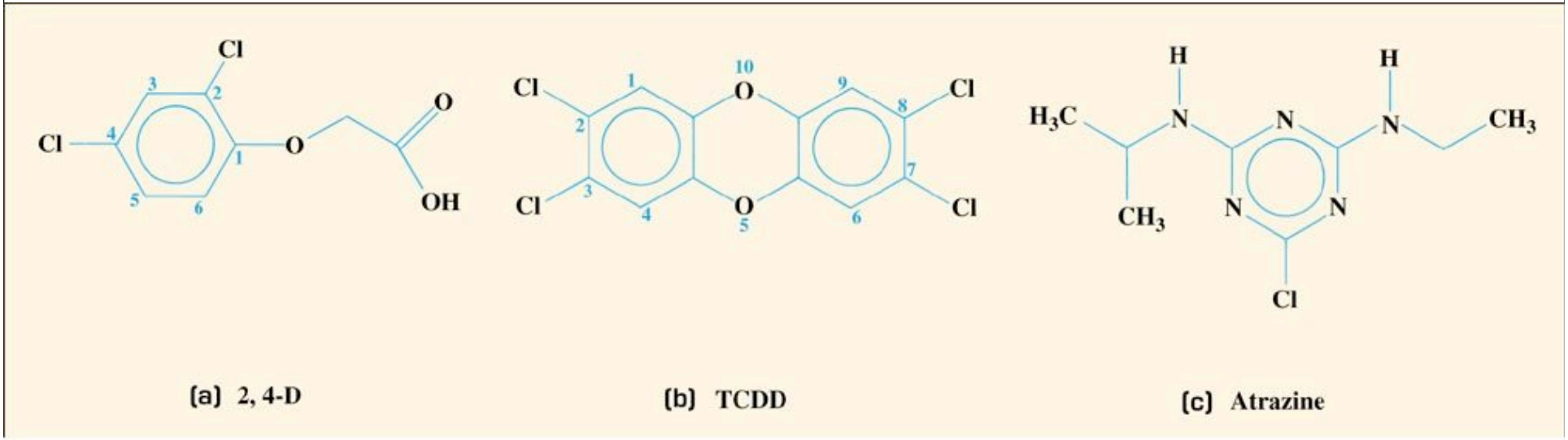
Structure of some small molecule pesticides

Kill insects indiscriminately. Also be toxic to humans.



Structure of some small molecule herbicides

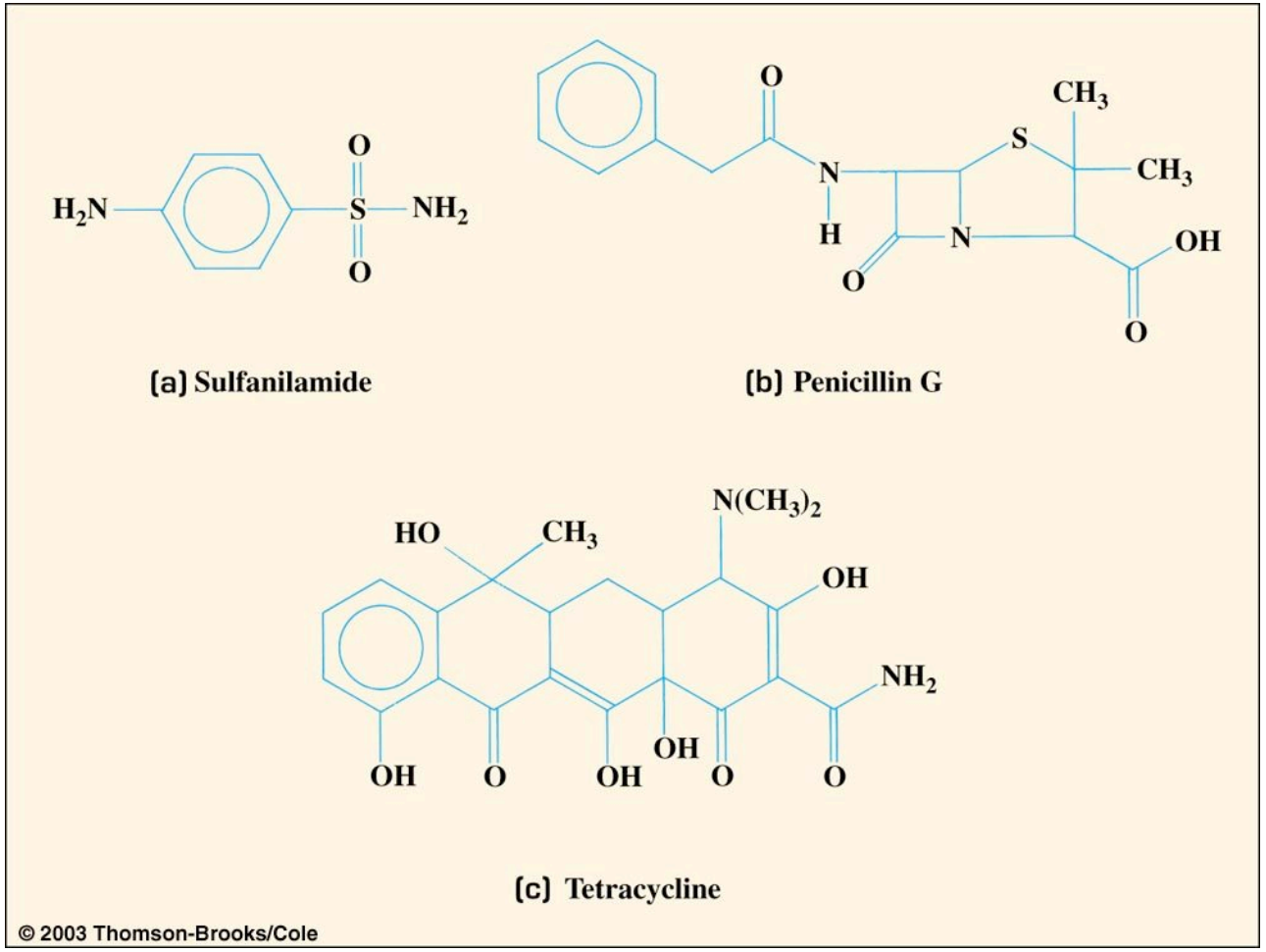
Kill only insects; some attract insects and make them sterile



(a) 2, 4-D (b) TCDD (c) Atrazine

Structure of some small molecule antibiotics and

Bacteria mistake molecule (a) for a molecule they need to make folic acid. This mistake kills them.



Structure of some steroids

Cholesterol is found in all tissues of the body

Human sex hormones are structurally based on cholesterol