RENCANA PEMBELAJARAN SEMESTER (RPS)

Kimia Organik Farmasi

FAF 114 (3 SKS) Semester II

Pengampu matakuliah

Prof. Dr. Dachriyanus, Apt
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Program Studi Sarjana Farmasi
Fakultas Farmasi
Universitas Andalas
Padang, Tahun 2017

A. LATARBELAKANG

Mata kuliah ini merupakan mata kuliah wajib (Mata Kuliah Keahlian) bagi mahasiswa program studi S1 Ilmu Farmasi yang memberikan pemahaman tentang karakteristik berbagai gugus fungsi. Bidang kajian ini terkait dengan kompetensi mahasiswa dalam memeriksa kemurnian dan menetapkan kadar bahan aktif farmakologis dan eksipient dalam sediaan farmasi

B. PERENCANAANPEMBELAJARAN

1. Deskripsi Singkat Matakuliah

Mata kuliah Kimia Organik Farmasi mempelajari tentang Kimia Organik Gusus Fungsi yang mencakup sifat fisika dan sifat kimiawi dari senyawa organik yang meliputi; senyawa organik turunan metil, senyawa organik dengan atom karbon elektrofilik (alkohol, alkil halida, eter dan epoksida, aldehid dan keton, asam karboksilat dan turunannya); senyawa organik dengan atom karbon nukleofilik (alkana, alkena, alkuna dan senyawa aromatic); senyawa alifatik – aromatik; amina, asam amino, peptida, protein, lemak, karbohidtrat dan asam nukleat.

2. Tujuan Pembelajaran

Setelah mengikuti mata kuliah ini diharapkan mahasiswa mampu :

1. Memahami dan menguasai sifat-sifat, tata nama, reaktivitas, pembuatan dan reaksi-reaksi senyawa organic gugus fungsi seperti senyawa karbonil, yang meliputi aldehida, keton, asam karboksilat dan turunannya (asil halida, anhidrida asam, ester, amida, dan nitril), karbohidrat (mono-, di- dan polisakarida), protein, lemak, karbohidrat dan asam nukleat.
2. Mengidentifikasi gugus fungsi dalam senyawa obt.

3. Capaian Pembelajaran (*Learning Outcomes*) dan Kemampuan Akhir yang Diharapkan

a. Sikap : Menggunakan dan mengembangkan kreativitas dan inovasi secara saintifik dalam memecahkan masalah kefarmasian.

b. Keterampilan Umum ; Memeriksa kemurnian dan menetapkan kadar bahan aktif

farmakologis dan eksipient dalam sediaan farmasi.

c. Keterampilan Khusus : Memanfaatkan dan mengembangkan bahan alam sebagai bahan baku obat.

d. Pengetahuan : Menguasai Teori, Konsep terkait teknik spektroskopi.

4. Bahan Kajian (Materi Ajar) dan Daftar Referensi

Bahan Kajian

1. Pengantar Kimia Organik II
2. Senyawa organik turunan metal
    - Metil, metanol, alkil halida, metil amina, dll
3. Alkohol dan alkil halide
    - Tata nama alkohol dan alkil halida, sifat-sifat alkohol dan alkil halida, pembuatan dan reaktifitas
4. Eter dan Epoksida
    - Tata nama eter dan epoksida
    - Sifat-sifat eter dan epoksida
    - Pembuatan dan reaktifitas
5. Aldehid dan keton
    - Tata nama aldehida dan keton
    - Sifat-sifat, pembuatan dan reaktifitas, reaksi-reaksi adisi nukleofilik aldehid dan keton
6. Asam karboksilat
    - Tata nama asam karboksilat
    - Struktur dan sifat-sifat asam karboksilat, dissosiasi asam karboksilat, pengaruh substituen, keasaman, pembuatan dan reaksi-reaksi asam karboksilat.
7. Turunan asam karboksilat
    - Reaksi substitusi asil nukleofilik
    - Tata nama, stabilitas, pembentukan dan reaksi asil halida dan anhidrida asam.
    - Tata nama, pembentukan dan reaksi-reaksi ester, amida dan nitril, keto-enol, tautomerisme, reaktivitas enol halogenasi alfa dari keton dan aldehida

8. Reaksi senyawa organik gol hidrokarbon alkana

    - Reaksi senyawa organik nukleofilik, tatanama, reaktifitas dan mekanisme reaksi.

9. Reaksi organik alkalkena dan alkuna

    - Mekanisme umum reaksi nukleofilik hidrokarbon tak jenuh, reaktifitas, mekanisme reaksi

10. Senyawa hidrokarbon aromatik dan alifatik

    - Tata nama, sifat dan reaksifitas reaksi subtitusi nukleofilik dan mekanisme reaksi

11. Karbohidrat

    - Definisi dan klasifikasi karbohidrat
    - Konfigurasi monosakarida: Proyeksi Fischer
    - Sistem D dan L
    - Konfigurasi aldosa
    - Struktur siklik monosakarida: Pembentukan hemiasetal
    - Anomer
    - Konformasi monosakarida
    - Mutarotasi
    - Reaksi-reaksi monosakarid
    - Pembentukan ester dan eter
    - Pembentukan glikosida
    - Oksidasi
    - Perpanjangan rantai
    - Pemendekan rantai
    - Disakarida
    - Polisakarida

12. Senyawa amina dan turunannya, protein

    - Struktur, sifat-sifat dan stereokimia asam amino
    - Klasifikasi asam amino
    - Elektroforesis
    - Reaksi-reaksi asam amino
    - Klasifikasi protein
    - Struktur protein

13. Lemak dan asam nukleat

- Struktur dan sifat asam lemak
- Pembentukan dan reaksi-reaksi trigliserida
- Struktur umum asam nukleat
- Perbedaan struktur DNA dan RNA

Daftar Referensi

Referensi Utama

1. Mc.Murry, J.E. Organic Chemistry, 9th Ed. Cengage Learning, USA, 2016
2. Klein, D.R, Organic Chemistry, 2nd Ed. , Wiley, New York, 2013

Referensi Pendukung

1. Eliei, E., Stereochemistry of Carbon Compounds, McGraw-Hill Com., Singapore, 1975.
2. Juaristi, J., Introduction to Stereochemistry and Conformational Analysis, John Willey & Son, New York, 1991.
3. March, J., Advanced Organic Chemistry; Reaction, Mechanism and Structures, 3rd Ed., John Wiley & Sons, New York, 1985.
4. Morrison, N.T. and R.N. Boyd, Organic Chemistry, 4th Ed., Allyn and Bacon Inc., Boston, 1983.
5. Solomons, G.T.W., Organic Chemistry, Revised printing, John Wiley & Sons, New York, 1978.
6. Streitwuieser, A. and C.H. Heathcock, Introduction to Organik Chenistry, 2nd Ed., Macmillan Publishing Co. Inc., New York, 1981.

5. Metode Pembelajaran dan Alokasi Waktu

Pembelajaran dilakukan dengan metoda Collaborative Learning, Cooperative Learning, serta Praktikum *;* atau metode lainnya yang termasuk pendekatan *Student Centered Learning (SCL).*

6. Pengalaman Belajar Mahasisiwa

Dalam mata kuliah ini mahasiswa akan mendapatkan pengalaman mencari informasi baik secara on-line dari artikel ilmiah atau buku-buku di perpustakaan Disamping itu kemampuan *soft-skill* berdiskusi dan memberikan pendapat dalam kelompok serta keberanian dalam memimpin dan mempresentasikan informasi baik secara baik didalam kelompok ataupun di depan kelas.

7. Kriteria (Indikator) Penilaian

Indikator penilaian meliputi; resume diskusi, kedisiplinan mengumpulkan tugas, keaktifan dalam diskusi, presentasi, Kuiz, Tugas, Ujian Tengah Semester, Ujian Akhir Semester

8. Bobot Penilaian

Kriteria penilaian terdiri atas penilaian hasil dan proses sesuai dengan capaian pembelajaran, dapat dihat pada Tabel 1.

Tabel 1. Kriteria (indikator) dan bobot penilain

No.	Komponen Penilaian	Bobot(%)
1.	Penilaian hasil	
a.	UTS	20
b.	UAS	40
2. Penilaian proses		
1.	Dimensi intrapersonal *skill*	10
2.	Atribut interpersonal *skill*	15
3.	Dimensi sikap dan tata nilai	15
	Total	100

9. Norma Akademik

Norma akademik yang diberlakukan dalam perkuliahan dapat berupa :

(1) Kehadiran mahasiswa dalam pembelajaran minimal 75% dari total pertemuan kuliah yang terlaksana,
(2) Kegiatan pembelajaran sesuai jadwal resmi dan jika terjadi perubahan ditetapkan bersama antara dosen dan mahasiswa,
(3) Toleransi keterlambatan 15menit,
(4) Selama proses pembelajaran berlangsung hp dimatikan kecuali pada saat diskusi kelompok
(5) Pengumpulan tugas ditetapkan sesuai jadwal,
(6) Yang berhalangan hadir karena sakit (harus ada keterangan sakit/surat pemberitahuan sakit) dan halangan lainnya harus menghubungi dosen sebelum perkuliahan
(7) Berpakaian sopan dan bersepatu dalam perkuliahan,
(8) Kecurangan dalam ujian, nilai mata kuliah yang bersangkutan nol.

10. Rancangan Tugas Mahasiswa

Tugas yang diberikan kepada mahasiswa berupa tugas untuk topic tertentu seperti :

1. Tata nama dan sifat dari senyawa golongan alcohol, eter, epoksida dan asam karboksilat
2. Reaksi – reaksi yang terlibat

	RENCANA PEMBELAJARAN SEMESTER (RPS) **PROGRAM STUDI : SARJANA FARMASI** **FAKULTAS /PPs: FARMASI** **UNIVERSITAS ANDALAS**

MATA KULIAH	**KODE**	**Rumpun MK**	**BOBOT (sks)**	**SEMESTER**	**Tgl Penyusunan**
Kimia Organik Farmasi	**FAF 114**	**Matakuliah Keahlian**	**3 (2,1)**	**II**	**18-1-2017**

OTORISASI	**Dosen Pengembang RPS**	**Koordinator Rumpun MK**	**Ka Program Studi**
	Prof. Dr. Dachriyanus, Apt **Prof. Dr. Dayar Arbain, Apt** **Prof. Dr. Deddi Prima Putra, Apt**		**Dr. Fatma Sri Wahyuni, Apt**

Capaian Pembelajaran (CP)	**CP Program Studi**	
	S6	Menggunakan dan mengembangkan kreativitas dan inovasi secara saintifik dalam memecahkan masalah kefarmasian.
	KU 2	Memeriksa kemurnian dan menetapkan kadar bahan aktif farmakologis dan eksipient dalam sediaan farmasi.
	KK1	Memanfaatkan dan mengembangkan bahan alam sebagai bahan baku obat.
	CP Mata Kuliah	
	1	Menjelaskan maksud dan tujuan pembelajaran, latar belakang dan kaitannya dgn farmasi dan profesi farmasi
	2	Membedakan senyawa organic turunan metil
	3	Mengidentifikasi nama dan sifat alcohol dan alkil halide serta cara pembuatannya
	4	Mengidentifikasi nama dan sifat eter dan epoksida serta cara pembuatannya
	5	Mengidentifikasi nama dan sifat aldehid dan keton serta cara pembuatannya
	6	Mengidentifikasi nama dan sifat asam karboksilat serta cara pembuatannya
	7	Mengidentifikasi nama dan sifat turunan asam karboksilat serta reaksi –reaksi yang terlibat
	8	Menggambarkan mekanisme reaksi nukleofilik senyawa organik gol hidrokarbon alkana
	9	Menggambarkan mekanisme reaksi nukleofilik organik alkalkena dan alkuna

Catatan :
S : Sikat
P : Pengetahuan
KU : Keterampilan Umum
KK : Keterampilan Khusus

	10	Mengidentifikasi nama dan sifat senyawa hidrokarbon aromatik dan alifatik
	11	Mengklasifikasikan karbohidrat dna menggambarkan bentuk – bentuk konfigurasinya
	12	Menjelaskan reaksi – reaksipada monosakarida
	13	Mengidentifikasi nama dan sifat senyawa amina dan turunannya, protein serta reaksi asam amino
	14	Menjelaskan struktur asam lemak serta perbedaan struktur DNA dan RNA
Deskripsi Singkat Mata Kuliah	Pada mata kuliah ini mahasiswa belajar tentang Kimia Organik Gusus Fungsi yang mencakup sifat fisika dan sifat kimiawi dari senyawa organik yang meliputi; senyawa organik turunan metil, senyawa organik dengan atom karbon elektrofilik (alkohol, alkil halida, eter dan epoksida, aldehid dan keton, asam karboksilat dan turunannya); senyawa organik dengan atom karbon nukleofilik (alkana, alkena, alkuna dan senyawa aromatic); senyawa alifatik – aromatik; amina, asam amino, peptida, protein, lemak, karbohidtrat dan asam nukleat.	
Materi Pembelajaran/ Pokok Bahasan	1. Pengantar Kimia Organik Farmasi 2. Senyawa organik turunan metal • Metil, metanol, alkil halida, metil amina, dll 3. Alkohol dan alkil halide • Tata nama alkohol dan alkil halida, sifat-sifat alkohol dan alkil halida, pembuatan dan reaktifitas 4. Eter dan Epoksida • Tata nama eter dan epoksida • Sifat-sifat eter dan epoksida • Pembuatan dan reaktifitas 5. Aldehid dan keton • Tata nama aldehida dan keton • Sifat-sifat, pembuatan dan reaktifitas, reaksi-reaksi adisi nukleofilik aldehid dan keton	

	6. Asam karboksilat • Tata nama asam karboksilat • Struktur dan sifat-sifat asam karboksilat, dissosiasi asam karboksilat, pengaruh substituen, keasaman, pembuatan dan reaksi-reaksi asam karboksilat. 7. Turunan asam karboksilat ▪ Reaksi substitusi asil nukleofilik ▪ Tata nama, stabilitas, pembentukan dan reaksi asil halida dan anhidrida asam. ▪ Tata nama, pembentukan dan reaksi-reaksi ester, amida dan nitril, keto-enol, tautomerisme, reaktivitas enol halogenasi alfa dari keton dan aldehida 8. Reaksi senyawa organik gol hidrokarbon alkana • Reaksi senyawa organik nukleofilik, tatanama, reaktifitas dan mekanisme reaksi. 9. Reaksi organik alkalkena dan alkuna • Mekanisme umum reaksi nukleofilik hidrokarbon tak jenuh, reaktifitas, mekanisme reaksi 10. Senyawa hidrokarbon aromatik dan alifatik • Tata nama, sifat dan reaksifitas reaksi subtitusi nukleofilik dan mekanisme reaksi 11. Karbohidrat • Definisi dan klasifikasi karbohidrat • Konfigurasi monosakarida: Proyeksi Fischer • Sistem D dan L

	• Konfigurasi aldosa • Struktur siklik monosakarida: Pembentukan hemiasetal • Anomer • Konformasi monosakarida • Mutarotasi • Reaksi-reaksi monosakarid • Pembentukan ester dan eter • Pembentukan glikosida • Oksidasi • Perpanjangan rantai • Pemendekan rantai • Disakarida • Polisakarida 12. Senyawa amina dan turunannya, protein • Struktur, sifat-sifat dan stereokimia asam amino • Klasifikasi asam amino • Elektroforesis • Reaksi-reaksi asam amino • Klasifikasi protein • Struktur protein 13. Lemak dan asam nukleat • Struktur dan sifat asam lemak • Pembentukan dan reaksi-reaksi trigliserida

	• Struktur umum asam nukleat • Perbedaan struktur DNA dan RNA
Pustaka	Utama : 1. Mc.Murry, J.E. Organic Chemistry, 9th Ed. Cengage Learning, USA, 2016 2. Klein, D.R, Organic Chemistry, 2nd Ed. , Wiley, New York, 2013 **Pendukung :** 1. Eliei, E., Stereochemistry of Carbon Compounds, McGraw-Hill Com., Singapore, 1975. 2. Juaristi, J., Introduction to Stereochemistry and Conformational Analysis, John Willey & Son, New York, 1991. 3. March, J., Advanced Organic Chemistry; Reaction, Mechanism and Structures, 3rd Ed., John Wiley & Sons, New York, 1985. 4. Morrison, N.T. and R.N. Boyd, Organic Chemistry, 4th Ed., Allyn and Bacon Inc., Boston, 1983. 5. Solomons, G.T.W., Organic Chemistry, Revised printing, John Wiley & Sons, New York, 1978. 6. Streitwuieser, A. and C.H. Heathcock, Introduction to Organik Chenistry, 2nd Ed., Macmillan Publishing Co. Inc., New York, 1981.
Media Pembelajaran	**Perangkat lunak :** / **Perangkat keras :** - / LCD & Projector
Team Teaching	1. Prof. Dr. Dachriyanus, Apt 2. Prof. Dr. Dayar Arbain, Apt 3. Prof. Dr. Deddi Prima Putra, Apt
Assessment	Kuiz, Tugas, Ujian Tengah Semester, Ujian Akhir Semester
Matakuliah Syarat	-

Pelaksanaan Perkuliahan 2 SKS

Mg Ke-	Kemampuan akhir yg diharapkan	Bahan Kajian (Materi Ajar) Dan Referensi	Metode Pembelajaran dan Alokasi Waktu	Pengalaman Belajar Mahasiswa	Kreteria (Indikator) Penilaian	Bobot Penilan (%)
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	Menjelaskan maksud dan tujuan pembelajaran, latar belakang dan kaitannya dgn farmasi dan profesi farmasi	Kimia organik gugus fungsi, maksud dan tujuan pembelajaran, latar belakang dan kaitannya dgn farmasi dan profesi farmasi **Referensi** 1,2	Kuliah	Mendengar	**Indikator** - **Bentuk non-test**; -	-
2	Membedakan senyawa organic turunan metil	Metil, metanol, alkil halida, metil amina, dll	Kuliah, Latihan	Mendengar Melaksanakan latihan	**Indikator** • Ketepatan dalam menjawab soal - soal yang berkaitan dengan senyawa turunan metil •	**-**
3	Mengidentifikasi nama dan sifat alcohol dan alkil halide serta cara pembuatannya	Tata nama alkohol dan alkil halida, sifat-sifat alkohol dan alkil halida, pembuatan dan reaktifitas	Kuliah, diskusi	Mendengar Melaksanakan diskusi,	**Indikator** • Ketepatan mengidentifikasi gugus fungsi alcohol dan alkil halida	**5**

Mg Ke-	Kemampuan akhir yg diharapkan	Bahan Kajian (Materi Ajar) Dan Referensi	Metode Pembelajaran dan Alokasi Waktu	Pengalaman Belajar Mahasiswa	Kreteria (Indikator) Penilaian	Bobot Penilan (%)
					• Jumlah mahasiswa yang berpartisipasi dalam diskusi **Bentuk non-test**; •	
4	Mengidentifikasi nama dan sifat eter dan epoksida serta cara pembuatannya	Tata nama eter dan epoksida Sifat-sifat eter dan epoksida Pembuatan dan reaktifitas	Kuliah, Collaborative learning	Mencari informasi Melaksanakan diskusi,	**Indikator** • Jumlah mahasiswa yang berpartisipasi • Ketepatan mengidentifikasi nama gugus fungsi **Bentuk non-test**; Resume diskusi	**5**
5	Mengidentifikasi nama dan sifat aldehid dan keton serta cara pembuatannya	Tata nama aldehida dan keton Sifat-sifat, pembuatan dan reaktifitas, reaksi-reaksi adisi nukleofilik aldehid dan keton	Kuliah, Diskusi	Mendengarkan, Mencari informasi Melaksanakan diskusi,	**Indikator** • Jumlah mahasiswa yang berpartisipasi • Ketepatan mengidentifikasi nama gugus fungsi	**5**
6	Mengidentifikasi nama dan sifat asam karboksilat serta cara pembuatannya	Tata nama asam karboksilat Struktur dan sifat-sifat asam karboksilat, dissosiasi	Kuliah, Collaborative learning	Mencari informasi Melaksanakan diskusi,	**Indikator** Ketepatan identifikasi nama gugus fungsi **Bentuk non-test**; Resume diskusi	**5**

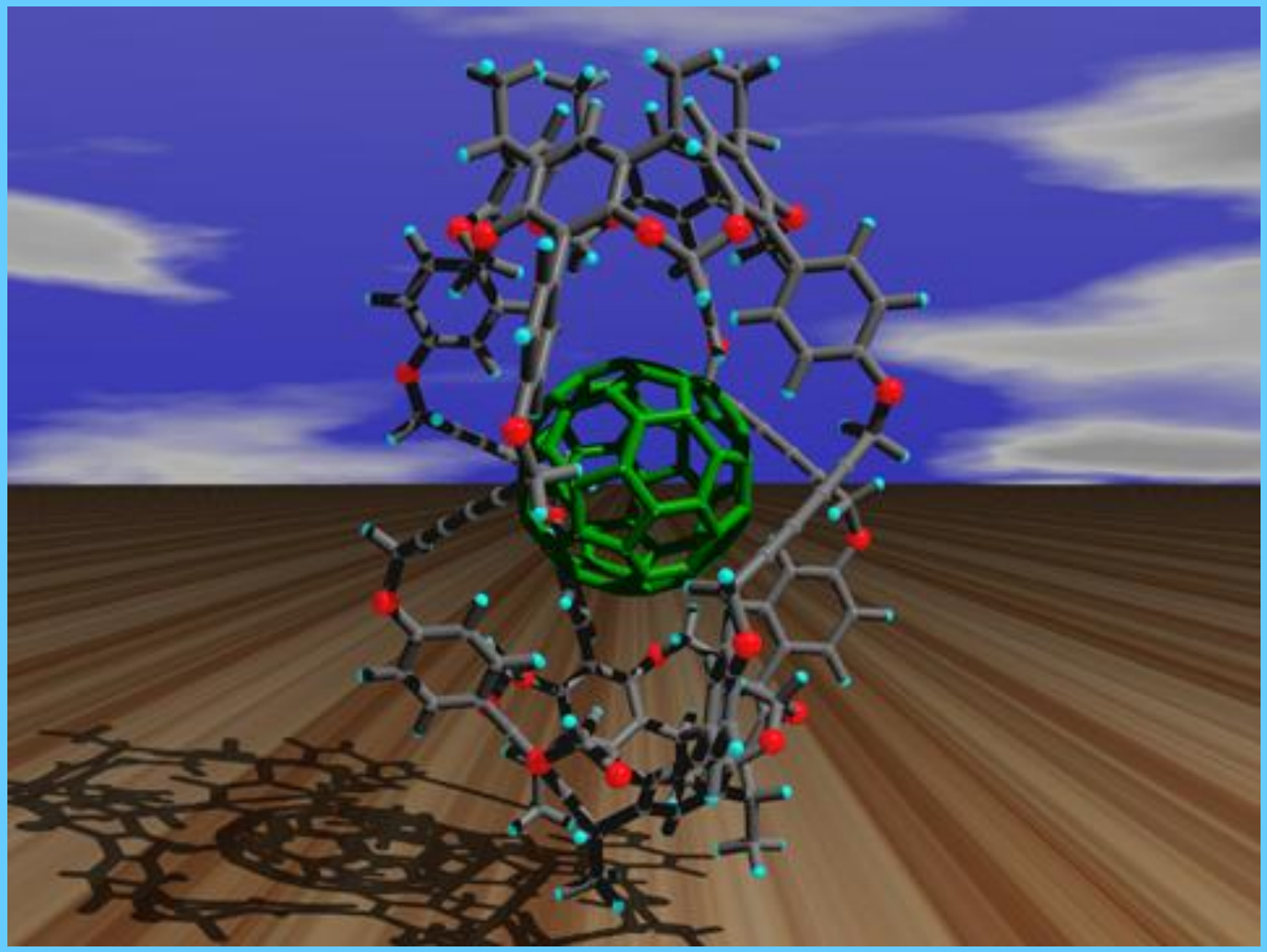
Mg Ke-	Kemampuan akhir yg diharapkan	Bahan Kajian (Materi Ajar) Dan Referensi	Metode Pembelajaran dan Alokasi Waktu	Pengalaman Belajar Mahasiswa	Kreteria (Indikator) Penilaian	Bobot Penilan (%)
		asam karboksilat, pengaruh substituen, keasaman, pembuatan dan reaksi-reaksi asam karboksilat.				
7	Mengidentifikasi nama dan sifat turunan asam karboksilat serta reaksi – reaksi yang terlibat	Reaksi substitusi asil nukleofilik Tata nama, stabilitas, pembentukan dan reaksi asil halida dan anhidrida asam. Tata nama, pembentukan dan reaksi-reaksi ester, amida dan nitril, keto-enol, tautomerisme, reaktivitas enol halogenasi alfa dari keton dan aldehida.	Kuliah, Collaborative learning	Mencari informasi Melaksanakan diskusi,	**Indikator** Ketepatan identifikasi nama gugus fungsi **Bentuk non-test**; Resume diskusi	
8	UJIAN TENGAH SEMESTER					**20**
9	Menggambarkan mekanisme reaksi nukleofilik senyawa organik gol hidrokarbon alkana	Reaksi senyawa organik nukleofilik, tatanama, reaktifitas dan mekanisme reaksi.	Kuliah Discovery Learning	Mencari informasi Melaksanakan diskusi,	**Indikator** Kejelasan struktur penjabaran dan sistimatika penyampaian baik dalam penyampaian lisan dan tulisan	

Mg Ke-	Kemampuan akhir yg diharapkan	Bahan Kajian (Materi Ajar) Dan Referensi	Metode Pembelajaran dan Alokasi Waktu	Pengalaman Belajar Mahasiswa	Kreteria (Indikator) Penilaian	Bobot Penilan (%)
10	Menggambarkan mekanisme reaksi nukleofilik organik alkalkena dan alkuna	Mekanisme umum reaksi nukleofilik hidrokarbon tak jenuh, reaktifitas, mekanisme reaksi	Kuliah Discovery Learning	Mendengarkan, Mencari informasi Melaksanakan diskusi,	**Indikator** Kejelasan struktur penjabaran dan sistimatika penyampaian baik dalam penyampaian lisan dan tulisan	
11	Mengidentifikasi nama dan sifat senyawa hidrokarbon aromatik dan alifatik	Tata nama, sifat dan reaksifitas reaksi subtitusi nukleofilik dan mekanisme reaksi	Kuliah Discovery Learning	Mendengarkan, Mencari informasi Melaksanakan diskusi,	**Indikator** Kejelasan struktur penjabaran dan sistimatika penyampaian baik dalam penyampaian lisan dan tulisan	
12	Mengklasifikasikan karbohidrat dna menggambarkan bentuk – bentuk konfigurasinya	Definisi dan klasifikasi karbohidrat Konfigurasi monosakarida: Proyeksi Fischer	Kuliah Collaborative Learning Diskusi	Mendengarkan, Mencari informasi Melaksanakan diskusi,	**Indikator** • Ketepatan pola fragmentasi, • Ketepatan argumentasi dalam menginterpretasi spektrum masa dari suatu senyawa obat	**5**

Mg Ke-	Kemampuan akhir yg diharapkan	Bahan Kajian (Materi Ajar) Dan Referensi	Metode Pembelajaran dan Alokasi Waktu	Pengalaman Belajar Mahasiswa	Kreteria (Indikator) Penilaian	Bobot Penilan (%)
		Sistem D dan L Konfigurasi aldosa Struktur siklik monosakarida: Pembentukan hemiasetal Anomer **Konformasi monosakarida** Mutarotasi				
13	Menjelaskan reaksi – reaksipada monosakarida	Reaksi-reaksi monosakarid - Pembentukan ester dan eter - Pembentukan glikosida - Oksidasi - Perpanjangan rantai - Pemendekan rantai Disakarida Polisakarida	Kuliah Collaborative Learning Diskusi	Mendengarkan, Mencari informasi Melaksanakan diskusi,	**Indikator** • Ketepatan pola fragmentasi, • Ketepatan argumentasi dalam menginterpretasi spektrum masa dari suatu senyawa obat Bentuk non test: Presentasi	**5**

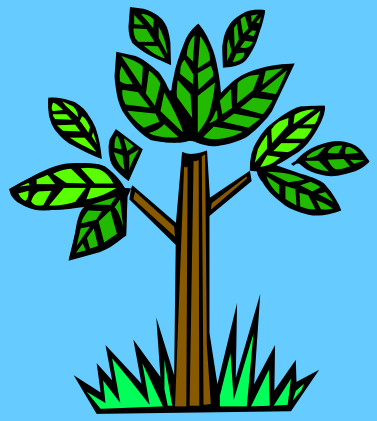
Mg Ke-	Kemampuan akhir yg diharapkan	Bahan Kajian (Materi Ajar) Dan Referensi	Metode Pembelajaran dan Alokasi Waktu	Pengalaman Belajar Mahasiswa	Kreteria (Indikator) Penilaian	Bobot Penilan (%)
14	Mengidentifikasi nama dan sifat senyawa amina dan turunannya, protein serta reaksi asam amino	Struktur, sifat-sifat dan stereokimia asam amino Klasifikasi asam amino Elektroforesis Reaksi-reaksi asam amino Klasifikasi protein Struktur protein	Kuliah Collaborative Learning Diskusi	Mendengarkan, Mencari informasi Melaksanakan diskusi,	**Indikator** • Ketepatan pola fragmentasi, • Ketepatan argumentasi dalam menginterpretasi spektrum masa dari suatu senyawa obat Bentuk non test: Presentasi	
15	Menjelaskan struktur asam lemak serta perbedaan struktur DNA dan RNA	Struktur dan sifat asam lemak Pembentukan dan reaksi-reaksi trigliserida Struktur umum asam nukleat Perbedaan struktur DNA dan RNA	Kuliah Collaborative Learning Diskusi	Mendengarkan, Mencari informasi Melaksanakan diskusi,	**Indikator** • Ketepatan pola fragmentasi, • Ketepatan argumentasi dalam menginterpretasi spektrum masa dari suatu senyawa obat Bentuk non test: Presentasi	
16	Ujian Akhir Semester					**40**

Organic Chemistry

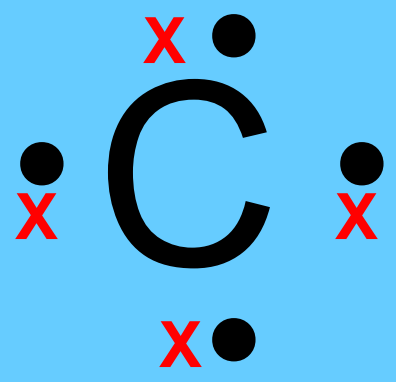


Organic Chemistry- The study of carbon & carbon compounds

- Organic compounds are the primary constituents of all living organisms.



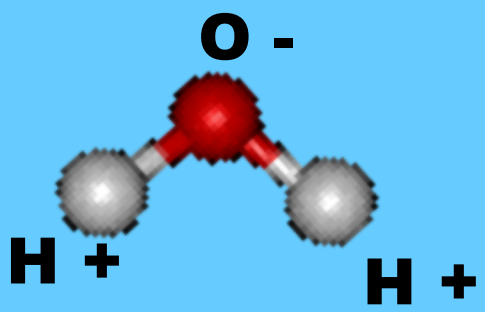
Draw an electron dot diagram of carbon.



Carbon is able to form 4 covalent bonds (4 valence electrons) with other carbon or other elements.

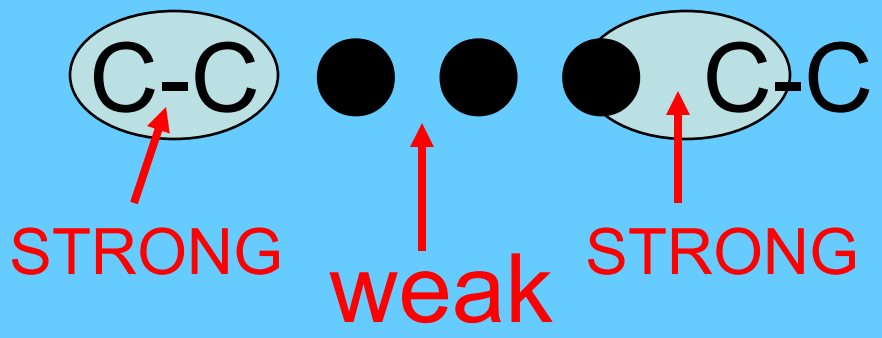
II. Characteristics of Organic Compounds

- They are nonpolar compounds – they do not dissolve in polar solvents like Water.



*remember the rule – "likes dissolve likes"

4) They have low melting points – due to weak intermolecular forces.

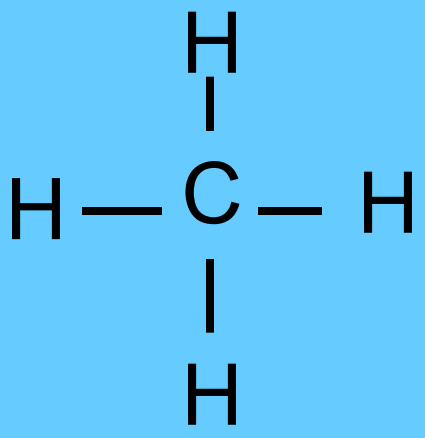


5) They react slower than ionic compounds – due to strong covalent bonds between atoms.

Structural Formulas –

A 2D model shows bonding patterns and shapes of molecules

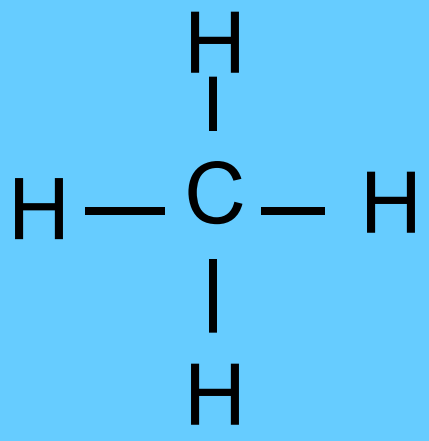
⇨ Carbon is found in the center



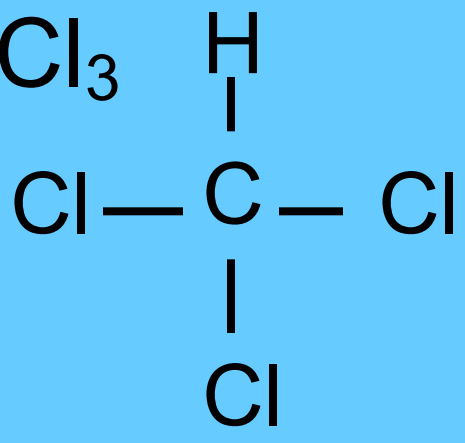
⇨ The short line – represents a pair of electrons.

Draw the structures for each organic

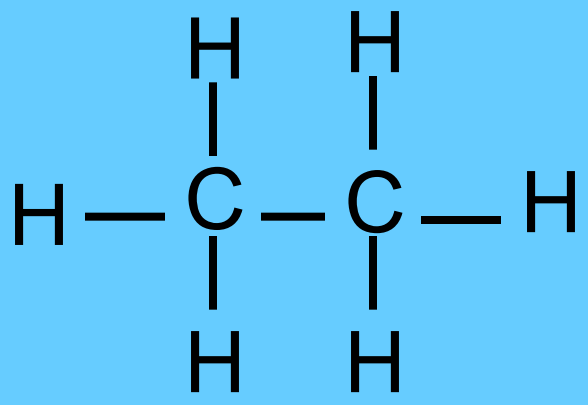
1. Methane: CH_4



2. Chloroform: $CHCl_3$



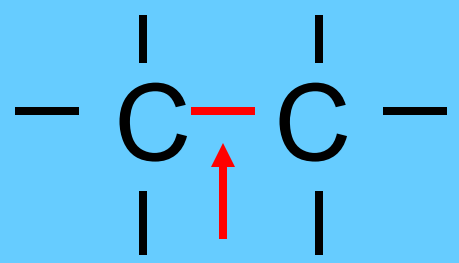
3. Ethane: C_2H_6

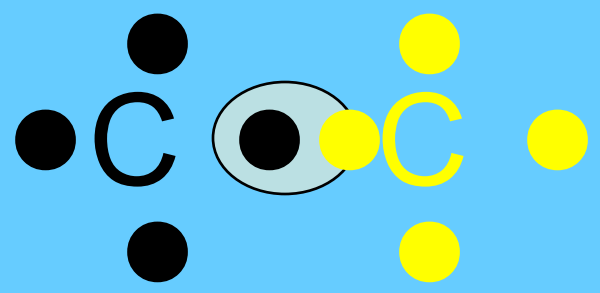


Remember : Carbon has **4** bonding sites.

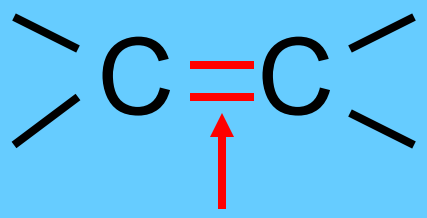
Types Of Bonds

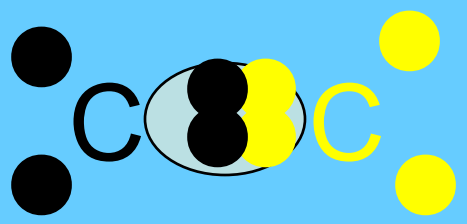
<u>Single Bond</u> – single covalent bond in which they share **1** pair of electrons. (2 e-)



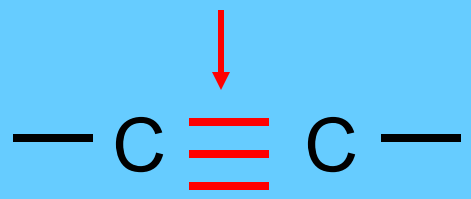


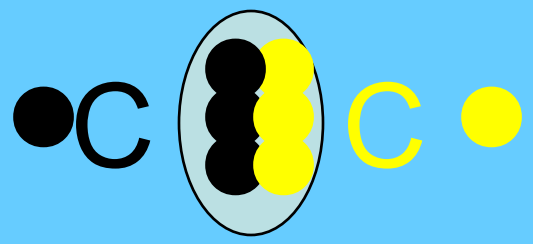
<u>Double Bond</u> – carbon atoms may share **2** pairs of electrons to form a double bond.





<u>Triple Bond</u> – carbon atoms may share **3** pairs of electrons to form a triple bond.

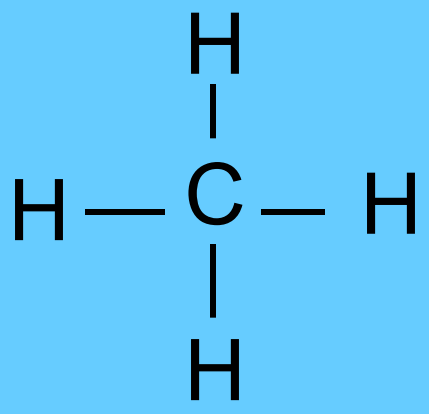




Types Of Compounds

Saturated Compound – organic compounds in which carbon atoms are bonded by SINGLE bonds.

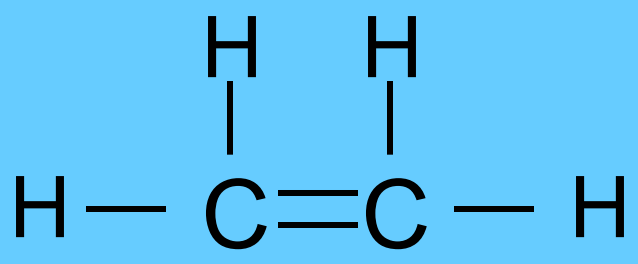
ex. Methane: CH_4



Types Of Compounds

<u>Unsaturated Compound</u> – compounds where carbon atoms have double or triple bonds.

ex. ethene: C_2H_4

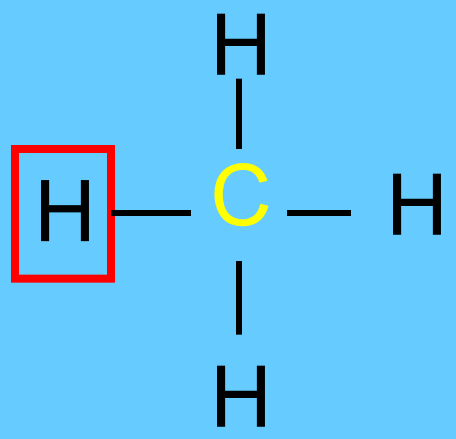


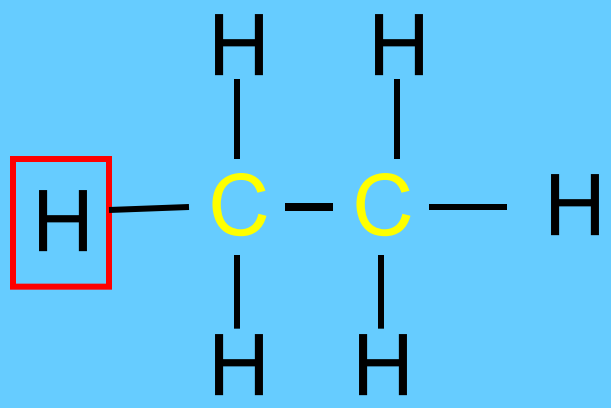
Homologous Series of Hydrocarbons

- Organic compounds can be classified into groups with related structures and properties.

***As size of molecule increases the boiling and freezing points increase.

<u>Hydrocarbons</u> are organic compounds that consist of only Carbon and Hydrogen atoms.





Base names

Prefix	Length of carbon chain
Meth	**1**
Eth	**2**
Prop	**3**
But	**4**
Pent	5
Hex	6
Hept	7
Oct	8
Non	9
Dec	10

Alkanes

Simplest members of the hydrocarbon family.

- contain only hydrogen and carbon
- only have single bonds
- Saturated hydrocarbons

All members have the general formula of

$$C_nH_{2n+2}$$

Twice as many hydrogen as carbon + 2

Alkanes = C_nH_{2n+2}

- A saturated hydrocarbon contains 5 carbons. What is the formula?

$C_5H_{2(5)+2}$ = C_5H_{12}

- A saturated hydrocarbon contains 20 carbons. What is the formula?

$C_{20}H_{2(20)+2}$ = $C_{20}H_{42}$

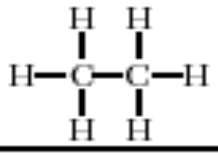
Saturated = Single

Alkanes

Table P
Organic Prefixes

Prefix	Number of Carbon Atoms
meth-	1
eth-	2
prop-	3
but-	4
pent-	5
hex-	6
hept-	7
oct-	8
non-	9
dec-	10

Table Q
Homologous Series of Hydrocarbons

Name	General Formula	Examples	
		Name	Structural Formula
alkanes	C_nH_{2n+2}	ethane	

- CH_4 = methane
- C_2H_6 = ethane
- C_3H_8 = propane
- C_4H_{10} = butane
- C_5H_{12} = pentane

Alkanes

The smaller the compound the Lower Boiling point and Melting point is (less bonds to break)

Name	BP (°C)	MP (°C)	Density
Methane	-161.7	-182.6	0.424
Ethane	- 88.6	-172.0	0.546
Propane	- 42.2	-187.1	0.582
Butane	-0.5	-135.0	0.579
Pentane	36.1	-129.7	0.626
Hexane	68.7	- 94.0	0.659
Heptane	98.4	- 90.5	0.684
Octane	125.6	- 56.8	0.703
Nonane	150.7	-53.7	0.718
Decane	174.0	-29.7	0.730

Naming Organic Compounds

- Organic compounds are named according to the IUPAC (international union of pure & applied chemistry) system of nomenclature.

Alkanes – end in ane

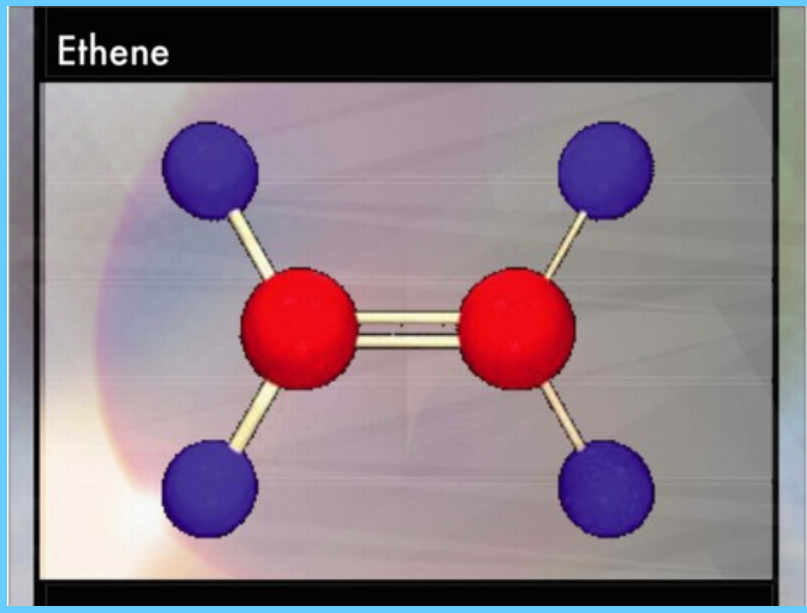
Alkenes – end in ene

Alkynes – end in yne

Alk*enes* – C_nH_{2n}

series of unsaturated hydrocarbons having one double bond (C=C)

- Also called ethylene series (IUPAC name is ethene)
- General formula C_nH_{2n}

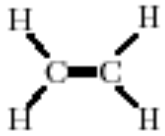


Alkenes

Table P
Organic Prefixes

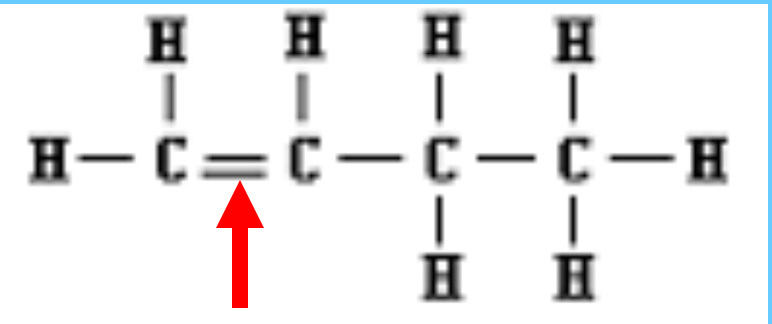
Prefix	Number of Carbon Atoms
meth-	1
eth-	2
prop-	3
but-	4
pent-	5
hex-	6
hept-	7
oct-	8
non-	9
dec-	10

Table Q
Homologous Series of Hydrocarbons

Name	General Formula	Examples	
		Name	Structural Formula
alkenes	C_nH_{2n}	ethene	

- C_2H_4 = Ethene
- C_3H_6 = Propene
- C_4H_8 = Butene
- C_5H_{10} = Pentene
- To find the number of hydrogens, double the number of carbons.

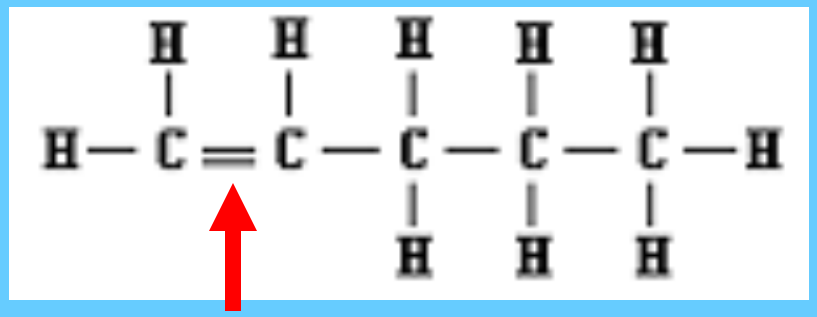
1-Butene



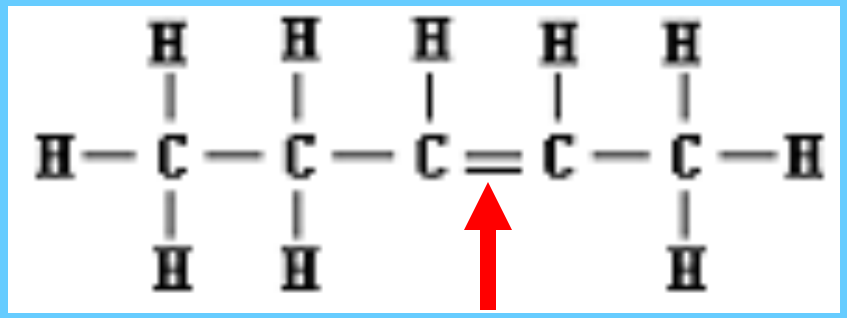
This is 1-butene, because the double bond is between the 1st and 2nd carbon from the end.

ISOMERS: Molecules have the same molecular formula, but have different structural formulas.

Pentene



This is 1-pentene. The double bond is on the first carbon from the end.

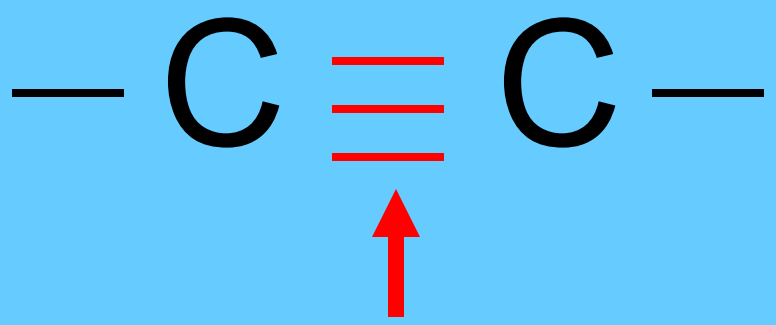


This is not another isomer of pentene. This is also 2-pentene, just that the double bond is closer to the right end.

Alk*ynes* – a series of unsaturated hydrocarbons that contain 1 triple bond.

- Also called the acetylene series

- General formula C_nH_{2n-2}



Alkynes

Table Q
Homologous Series of Hydrocarbons

Name	General Formula	Examples	
		Name	Structural Formula
alkynes	C_nH_{2n-2}	ethyne	H—C≡C—H

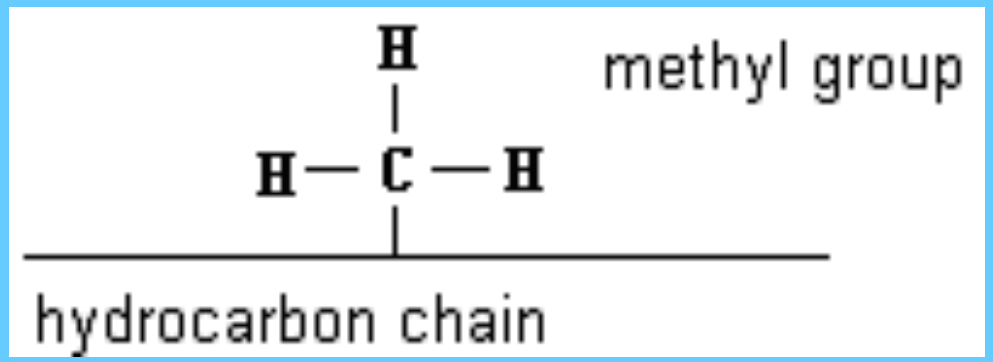
Table P
Organic Prefixes

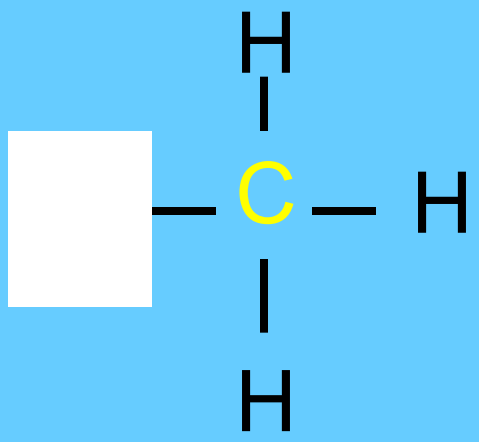
Prefix	Number of Carbon Atoms
meth-	1
eth-	2
prop-	3
but-	4
pent-	5
hex-	6
hept-	7
oct-	8
non-	9
dec-	10

- C_2H_2 = Ethyne
- C_3H_4 = Propyne
- C_4H_6 = Butyne
- C_5H_8 = Pentyne

Alkyl Groups – have one less hydrogen than the corresponding alkane.

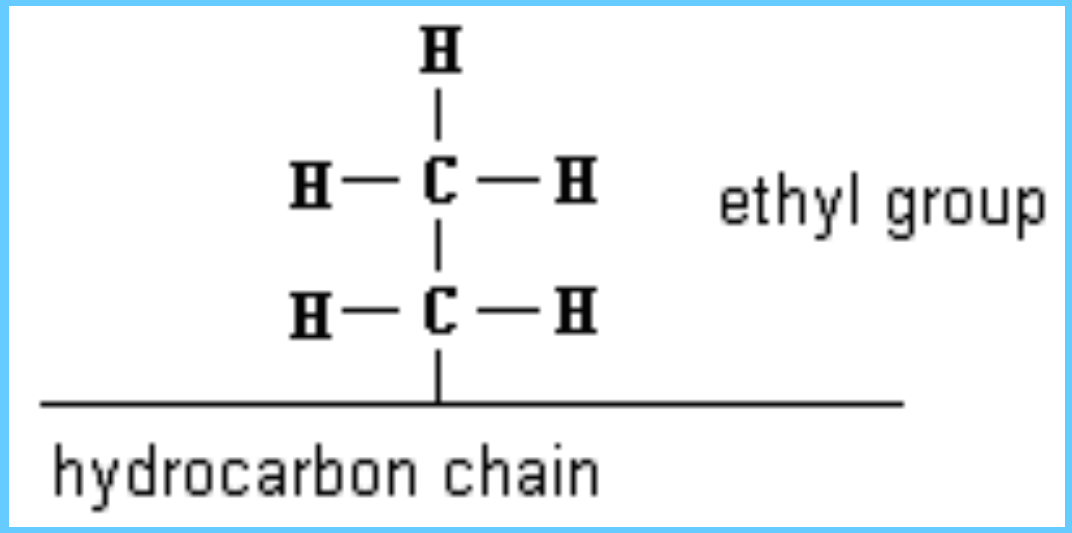
- CH_3 is methyl – one less H than methane, CH_4





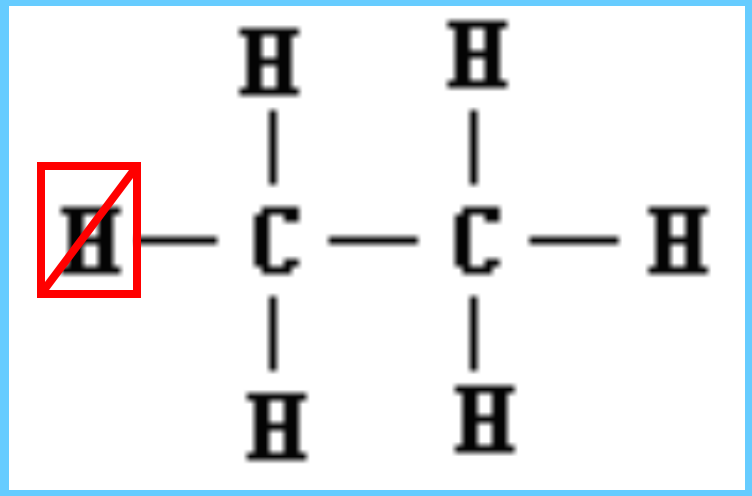
Draw methyl

- C_2H_5 is **ethyl** – one less H than ethane C_2H_6



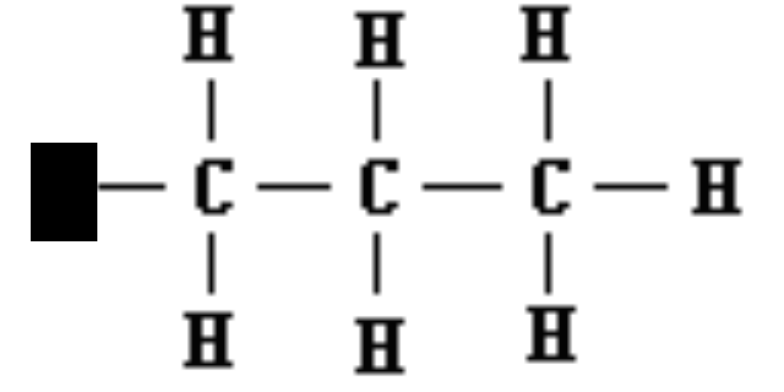
Condensed Formula:

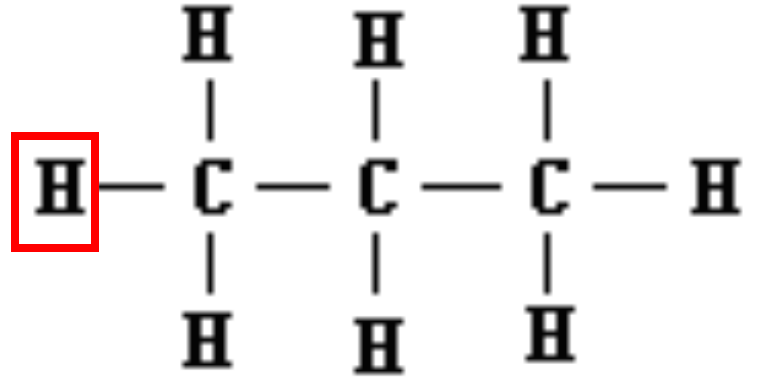
CH_2CH_3



Ethane

- C_3H_7 is **propyl** – one less H than propane C_3H_8



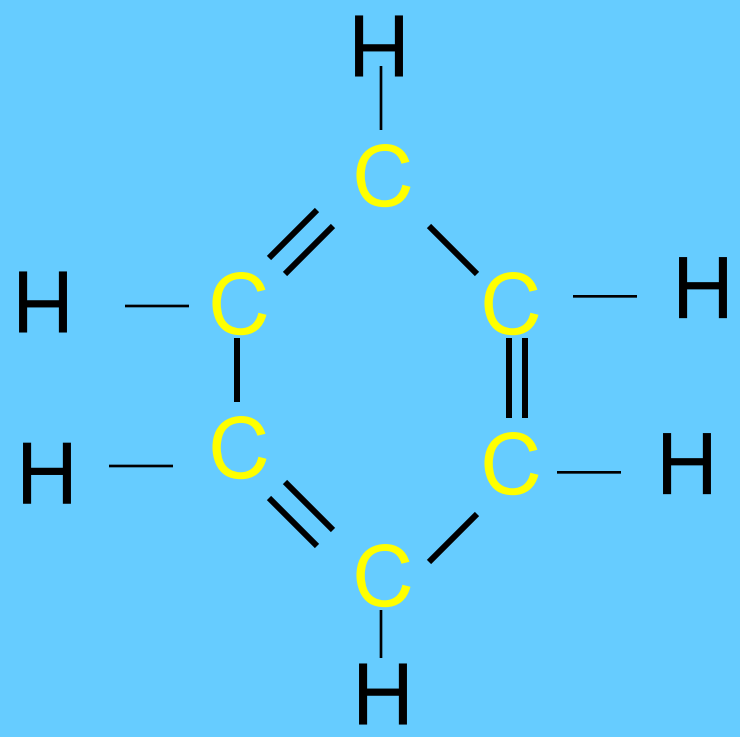


propane

Benzene – a series of cyclic unsaturated hydrocarbons.

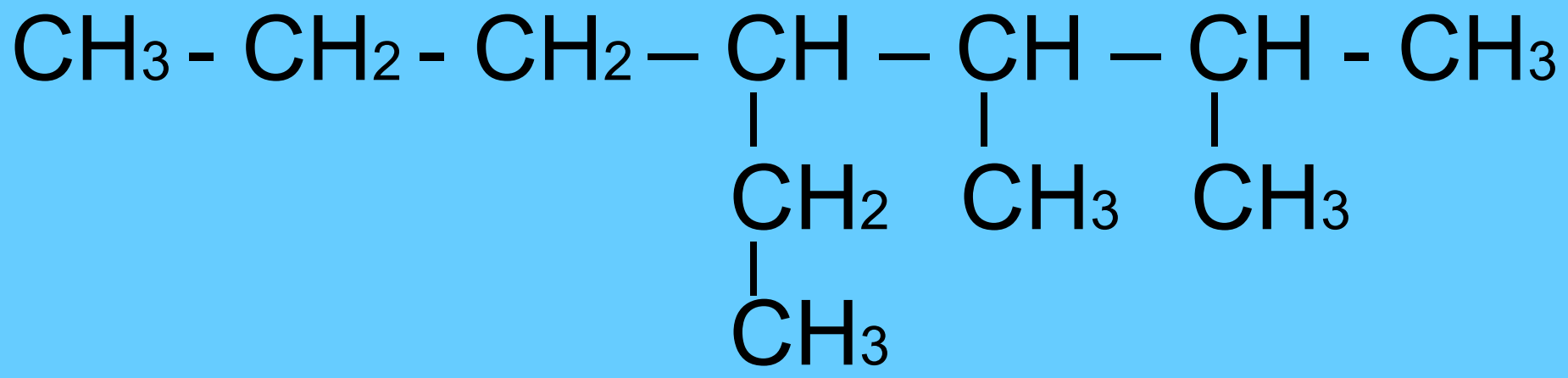
- General formula C_nH_{2n-6}

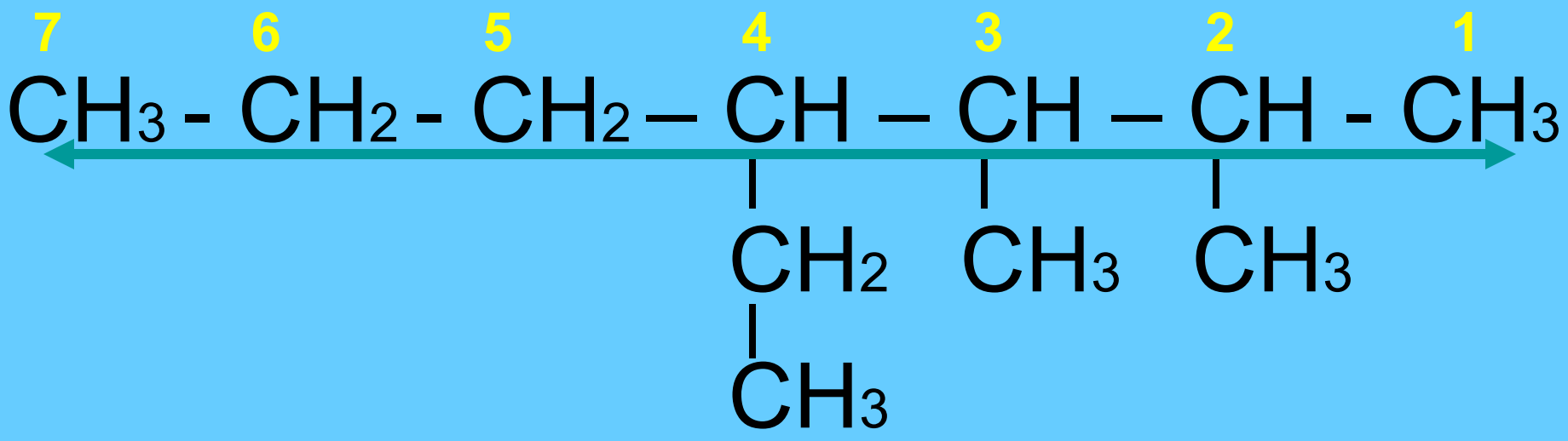
Benzene – C_6H_6 the simplest in the family



IUPAC Naming Branched Hydrocarbon Chains

Sometimes the hydrocarbon chains are not straight and sometimes they have other elements attached to them. Here is how they are named:

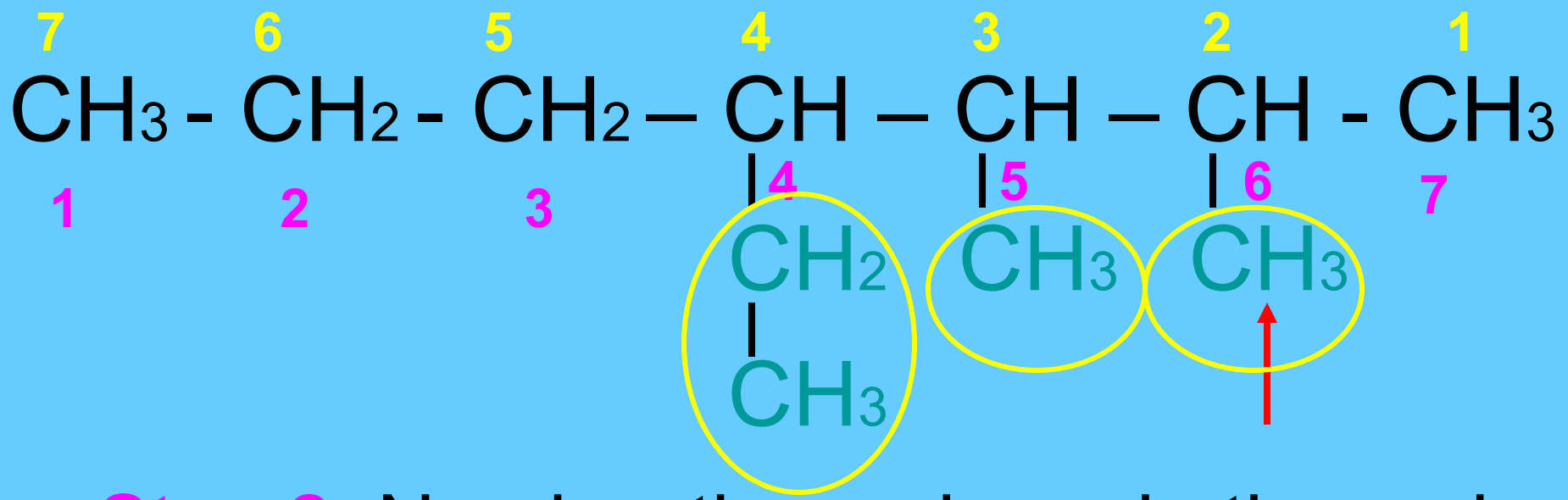




- Step 1: Find the longest continuous chain of carbons.

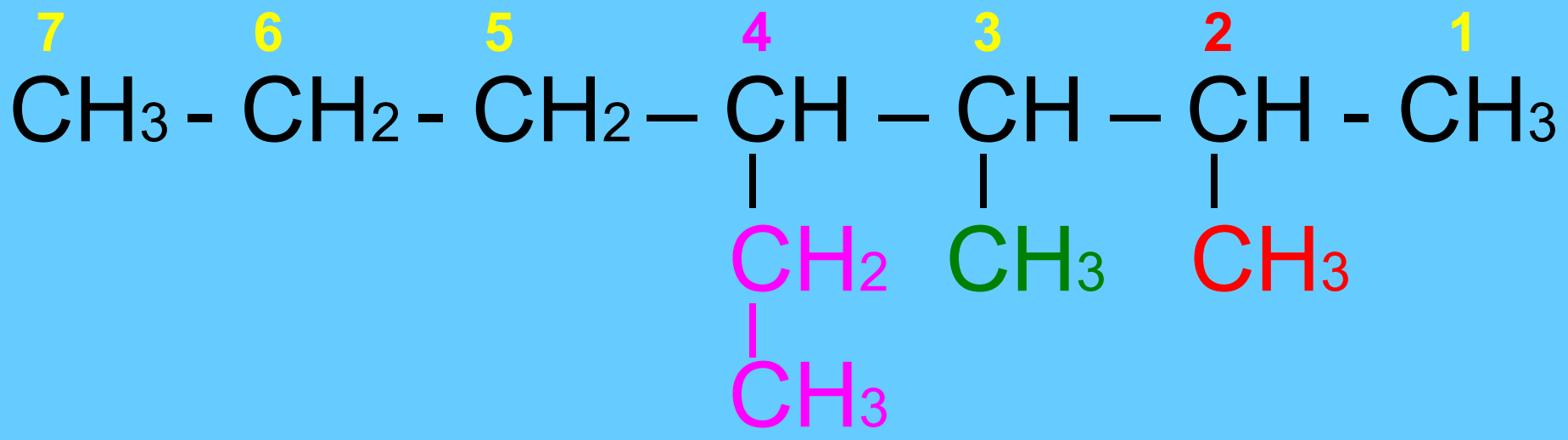
All bonds in the chain of carbons are single bonds so ending is…ane.

There are 7 continuous carbons, so the parent chain is heptane.



- Step 2: Number the carbons in the main sequence starting with the end that will give the attached groups the smallest #.

- This chain is numbered from right to left because there is a substituent closest to the right.



- Step 3 : Add numbers to the names of the groups to identify their positions on the chain.

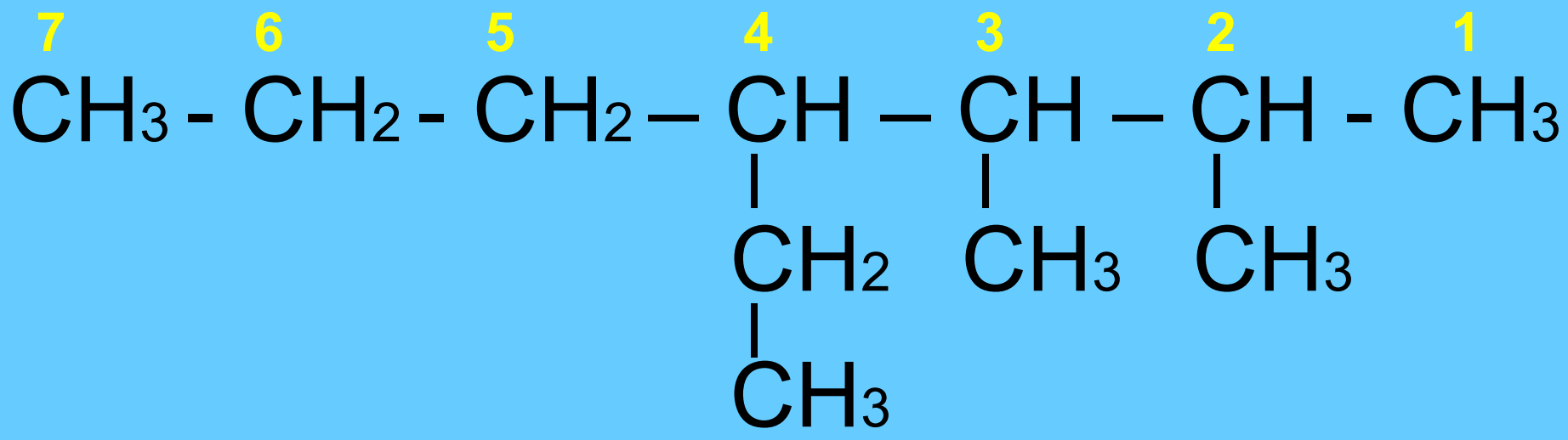
- these numbers become prefixes to the parent chain.

In this ex. the positions are:

~~ethane~~ yl

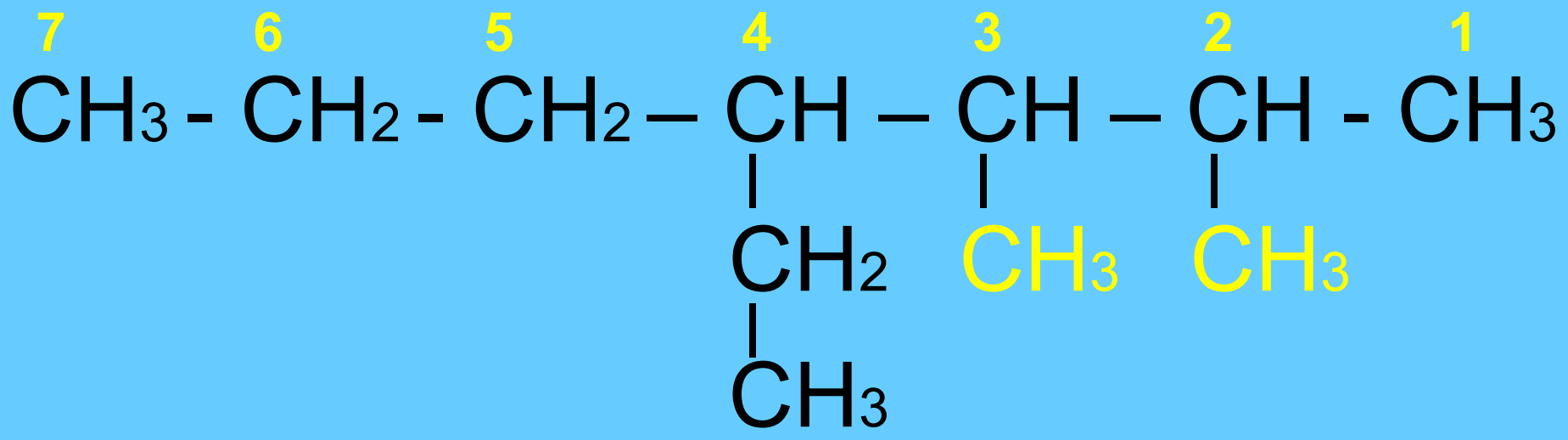
C_2H_6 5

2- methyl, 3- methyl, 4- ethyl



- Step 4: Use prefixes to indicate the appearance of a group more than once in the structure.

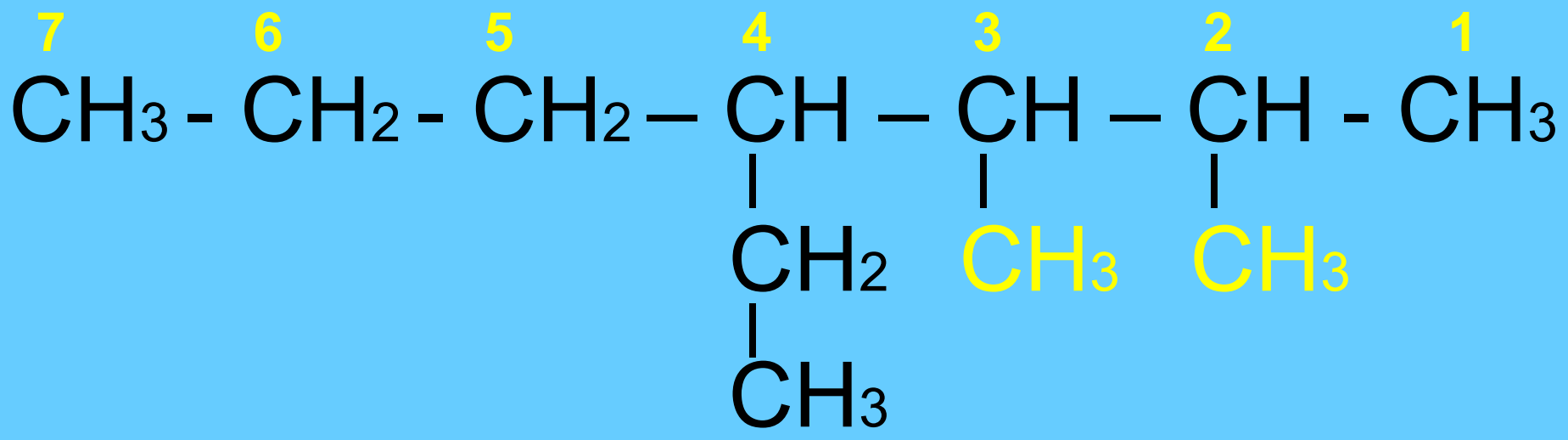
Di	=	twice
Tri	=	three times
Tetra	=	four times
Penta	=	five times



- This chain has 2 methyl groups so dimethyl is used.

Step 5: List the alkyl groups in alphabetical order.

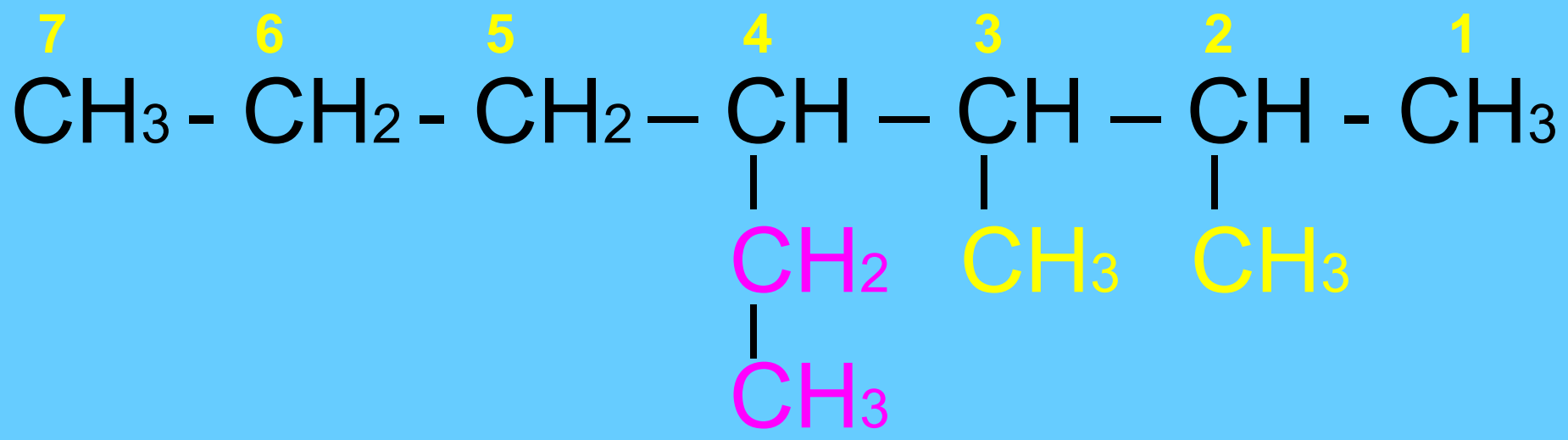
In this ex. dimethyl is listed before the ethyl.



Step 6: Use punctuation

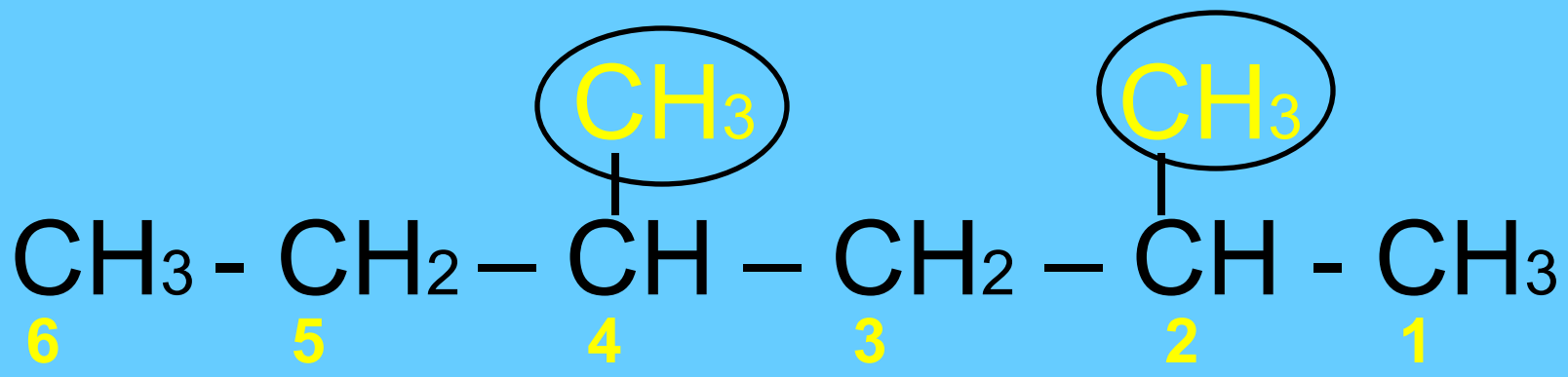
- use commas to separate numbers

-hyphens to separate numbers with words.



- The name of this compound is:

2,3-dimethyl – 4-ethyl heptane



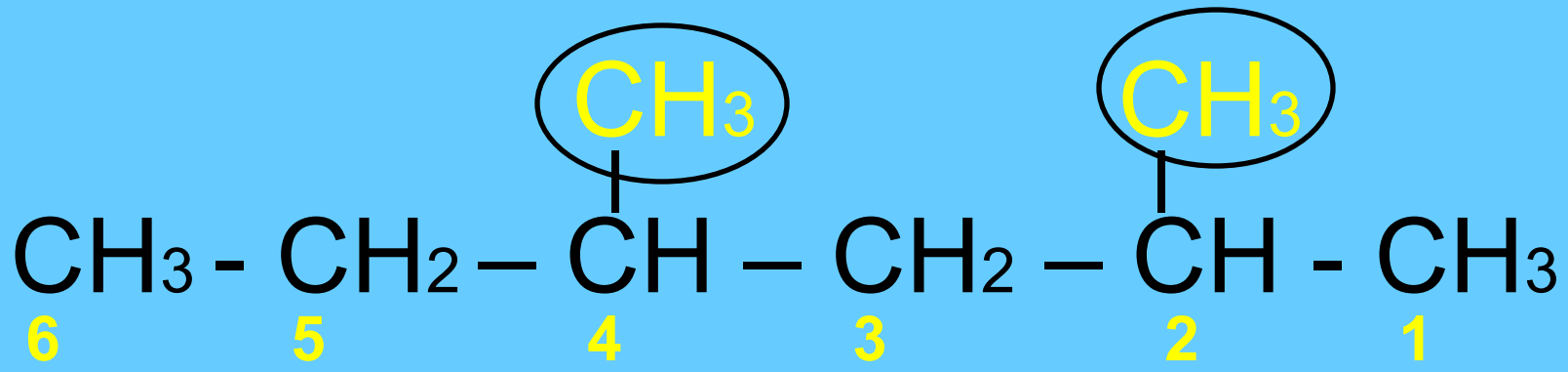
Step 1: 6 carbons = hex

All single bonds = ends in ane

So parent chain is hexane

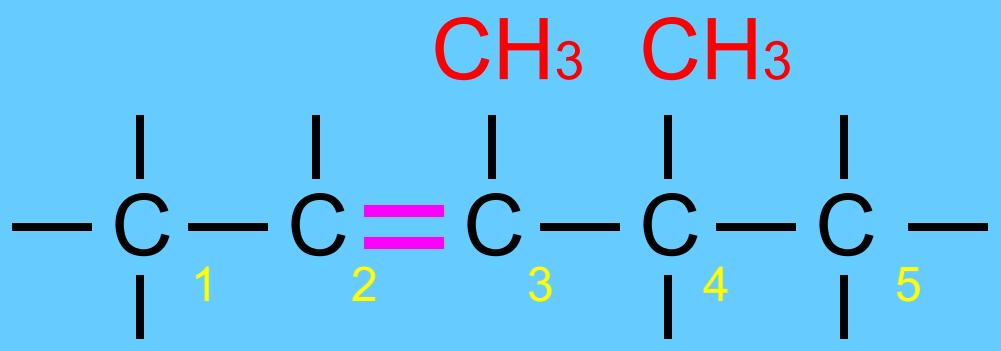
Step 2: start numbering from right to left

Step 3: 2 -methyl and 4-methyl



2,4 dimethyl hexane

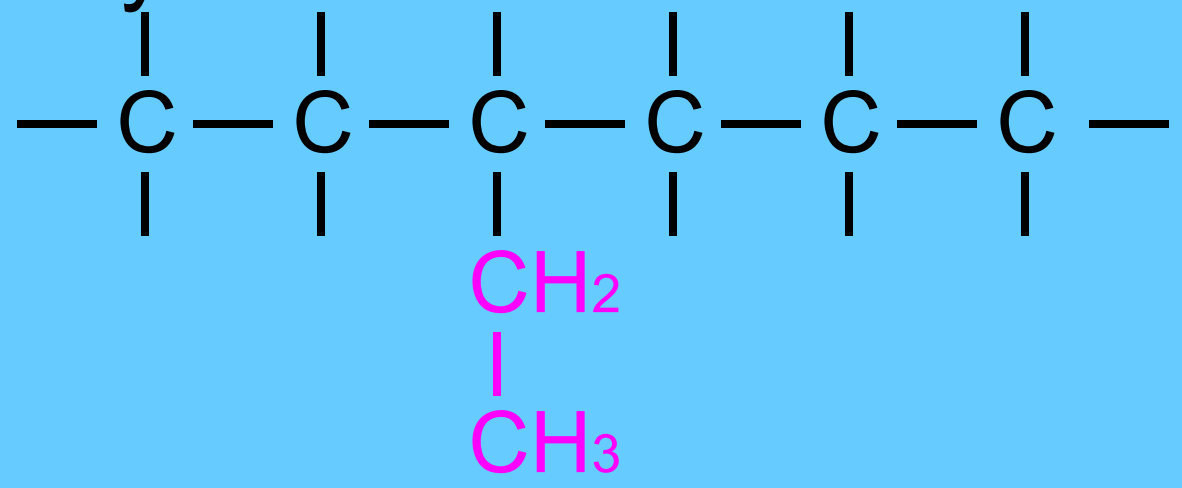
When naming with a double/triple bond- start # carbons closest to the bond.



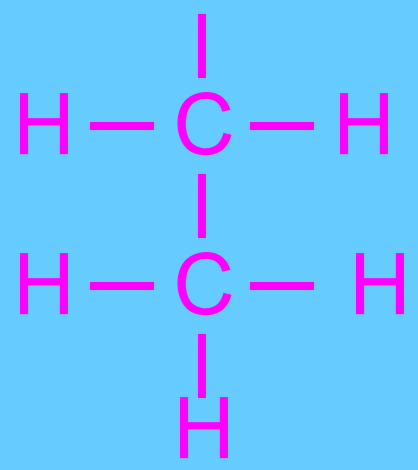
3,4 dimethyl, 2-pentene

Now start with name and draw the structure.

- 3-ethylhexane



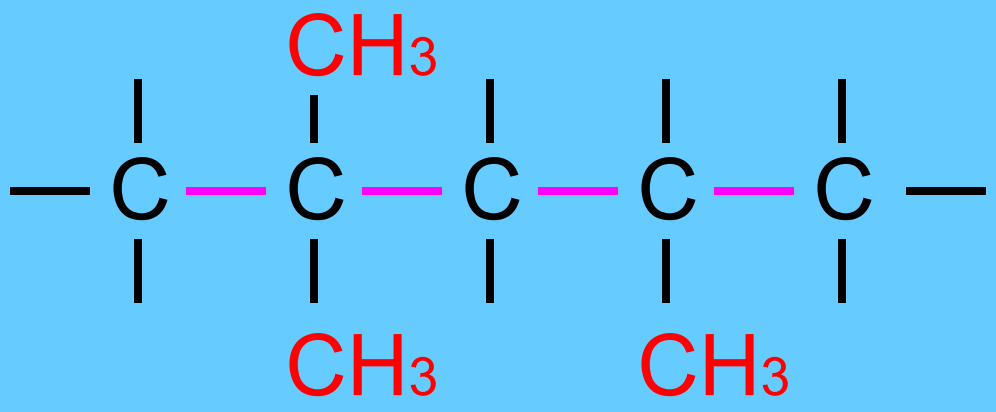
You can place H's all around or just leave as is.



~~ethane~~ yl

$C_2H_{\cancel{6}\,5}$

- 2,2,4-trimethylpentane



Other Organic Compounds

<u>Functional Groups</u> – specific groupings of atoms that give characteristic properties to organic compounds.

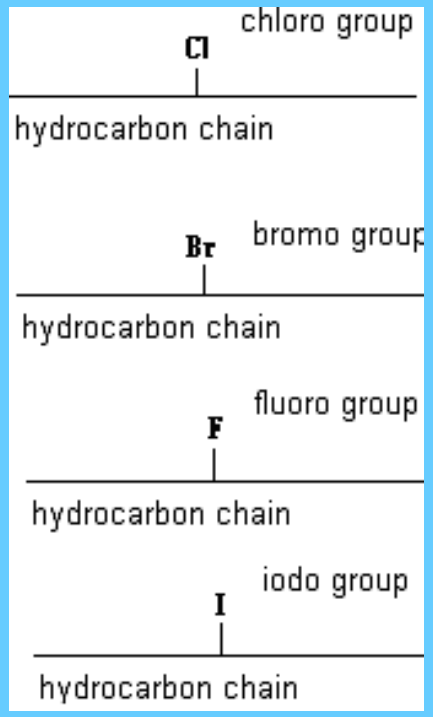
⇨ halides

F (fluoro-)

Cl (chloro-)

Br (bromo-)

I (iodo-)



What group do these belong to?

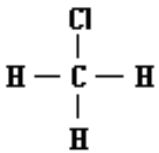
Halogens

- Alcohols -OH hydroxyl
- Organic acids -COOH carboxyl
- Aldehydes -CHO carbonyl
- Ketones $-\overset{\overset{\displaystyle O}{\|}}{C}-$
- Ethers -O-
- Esters $-\overset{\overset{\displaystyle O}{\|}}{C}-O$
- Amines $-\overset{|}{N}-$
- Amides $-\overset{\overset{\displaystyle O}{\|}}{C}-\overset{|}{N}H$

Halides

Cmpds that are formed when any halogen (F,Cl,Br,I) replaces an H atom in an alkane.

The functional group is the halide (F,Cl,Br,I)



One carbon = methane
Chlorine = chloro

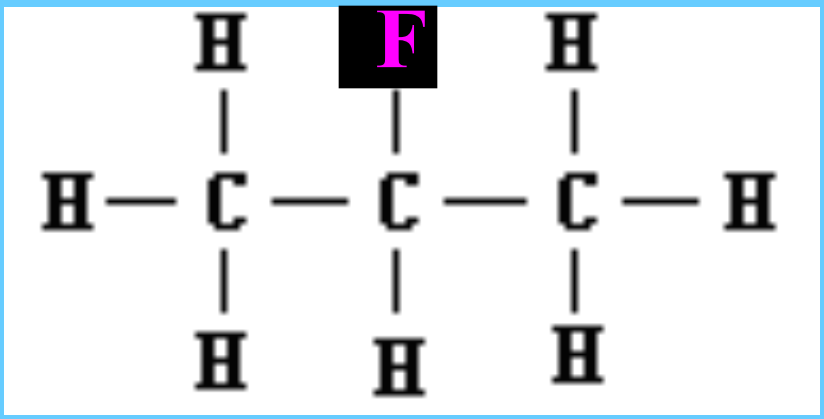
Chloro methane

[redacted]

Halides

- They are named by citing the location of the halogen attached to the chain

Drop the "ine" and add "o"



2- fluoropropane

Alcohols

- Are organic cmpds in which one or more of the hydrogens is replaced with an – OH group.

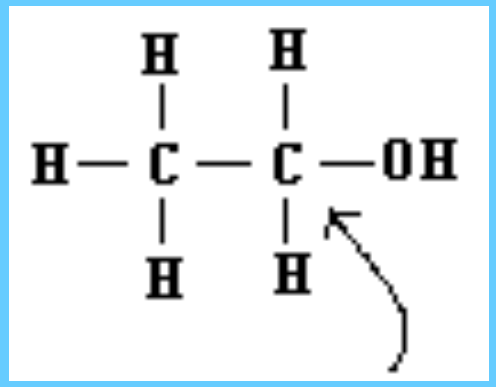
- OH group is called the hydroxyl group

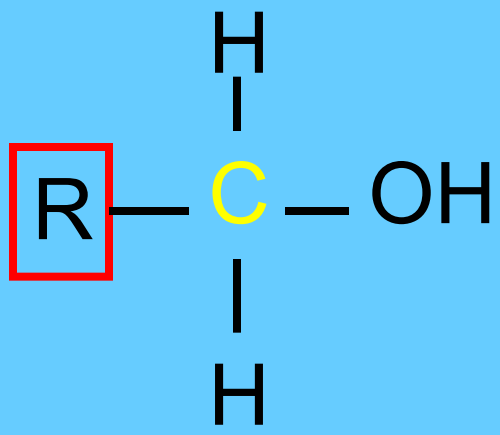
Table R
Organic Functional Groups

Class of Compound	Functional Group	General Formula	Example
alcohol	—OH	*R*—OH	$CH_3CH_2CH_2OH$ 1-propanol

Monohydroxyl Alcohols

-have one –OH group





Shortcut way to represent a primary alcohol

R-OH

R stands for REST of the molecule

IUPAC naming of alcohols

- Replace the final "e" with "-ol"
  - methane → methanol → CH_3OH
  - ethane → ethanol → C_2H_5OH
  - propane → propanol → C_3H_7OH
  - butane → butanol → C_4H_9OH
  - pentane → pentanol → $C_5H_{11}OH$

Example

C – C – C – C – O – H

Base contains 4 carbon

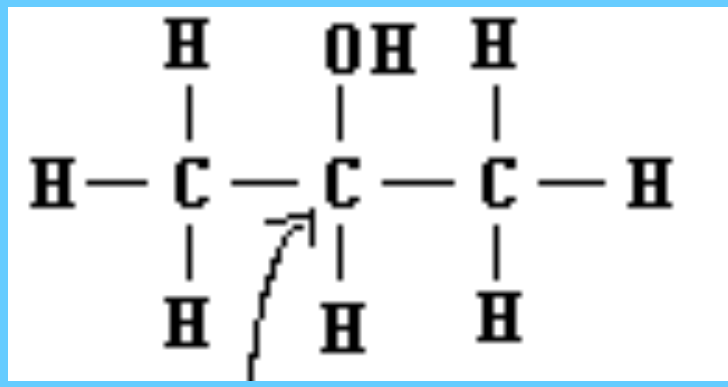
alkane name is butane

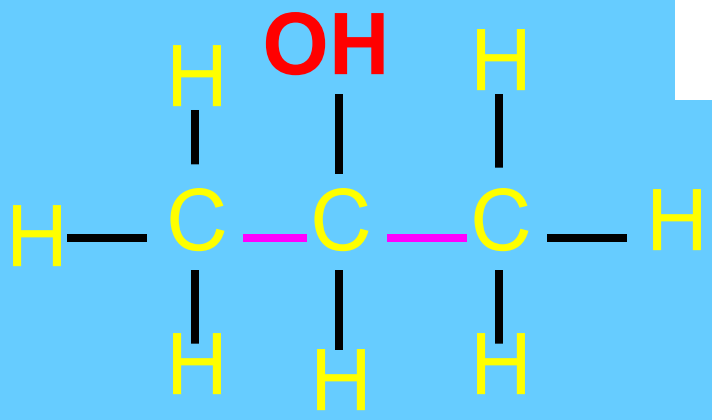
remove –e and add –ol

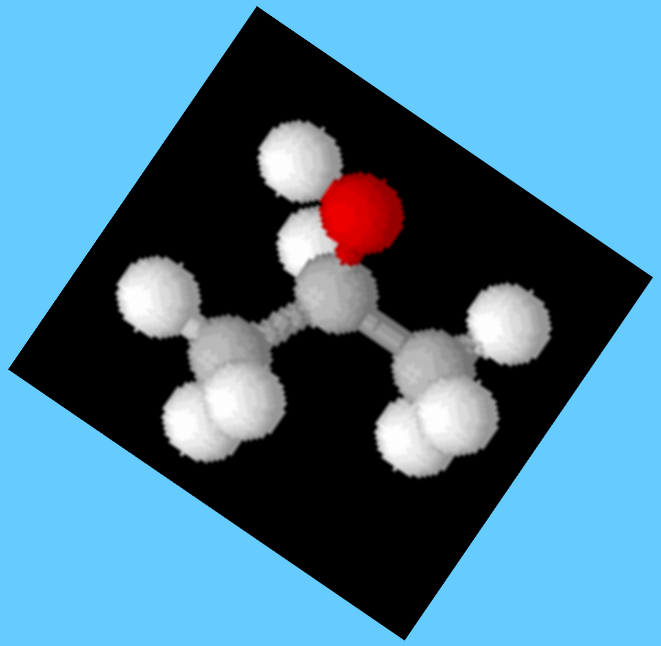
alcohol name – butanol

OH is on the first carbon so –
1–butanol

Ex. 2-propanol







Organic acids – have the functional group -COOH

- R-COOH

Carboxyl group

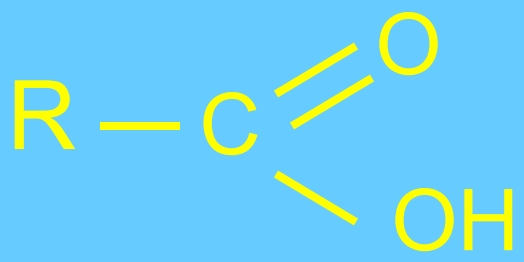


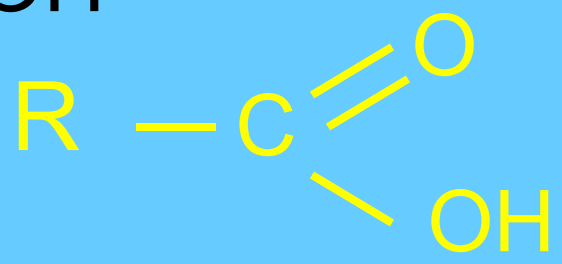
Table R
Organic Functional Groups

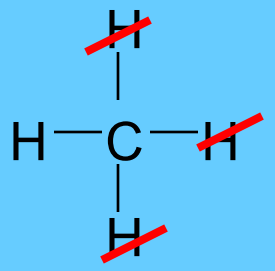
Class of Compound	Functional Group	General Formula	Example
organic acid	$-\overset{\overset{\large O}{\|\|}}{C}-OH$	$R-\overset{\overset{\large O}{\|\|}}{C}-OH$	$CH_3CH_2\overset{\overset{\large O}{\|\|}}{C}-OH$ propanoic acid

IUPAC naming of Organic Acids

- Replace the final “e” with “-oic ”acid

Methanoic acid - HCOOH





Aldehydes- contain the functional group -CHO

R-CHO

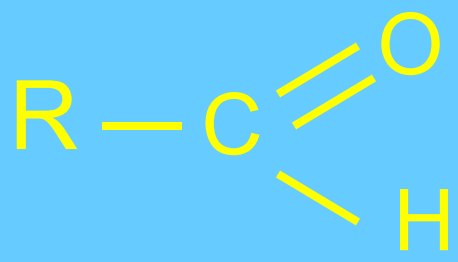


Table R
Organic Functional Groups

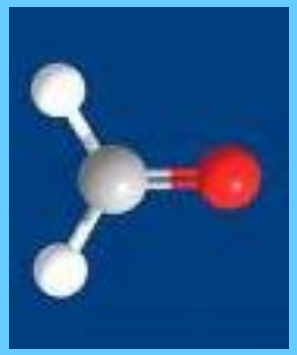
Class of Compound	Functional Group	General Formula	Example
aldehyde	$-\overset{\overset{\large O}{\|\|}}{C}-H$	$R-\overset{\overset{\large O}{\|\|}}{C}-H$	$CH_3CH_2\overset{\overset{\large O}{\|\|}}{C}-H$ propanal

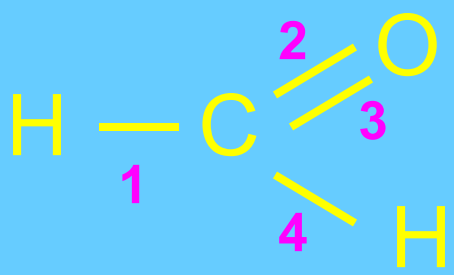
IUPAC naming of Aldehydes-

- Replace the final “e” the the ending “al”

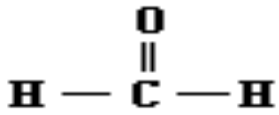
First member of the aldehyde family is methanal

-its common name is formaldehyde

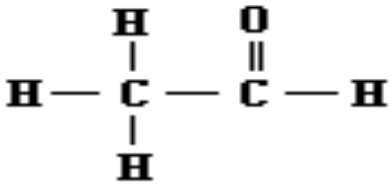




Used to preserve biological samples

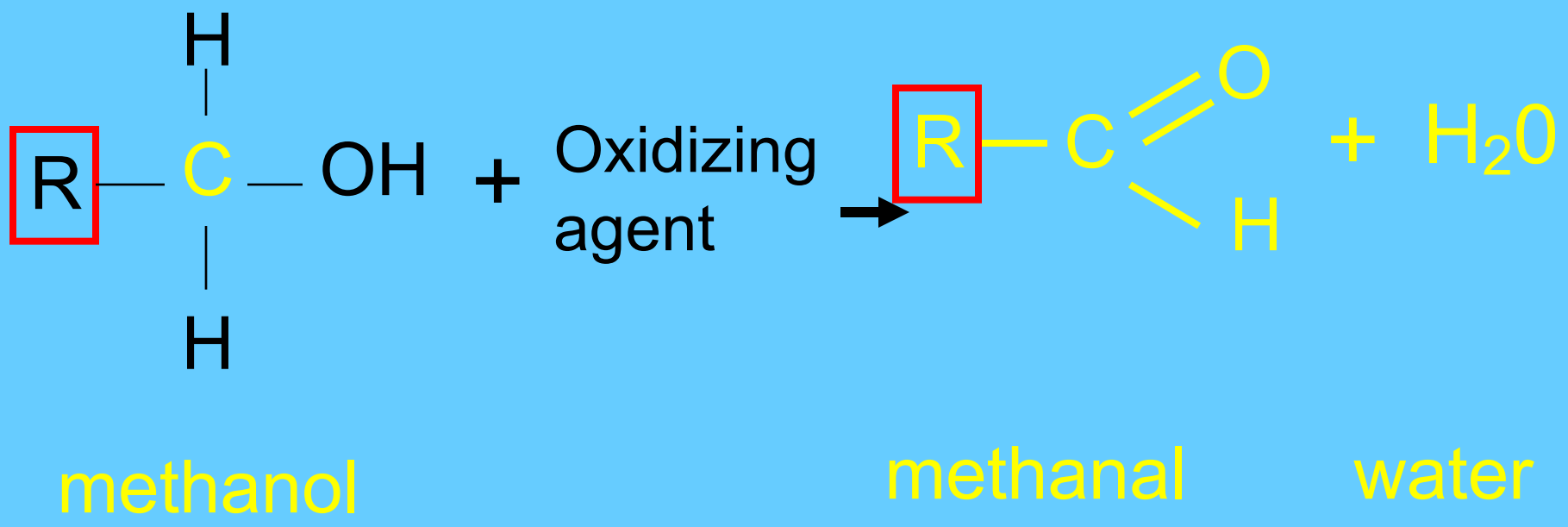


Methanal (formaldehyde): a one-carbon aldehyde. Used to preserve biological specimens and as a glue to hold the layers of plywood and oriented strand board together.

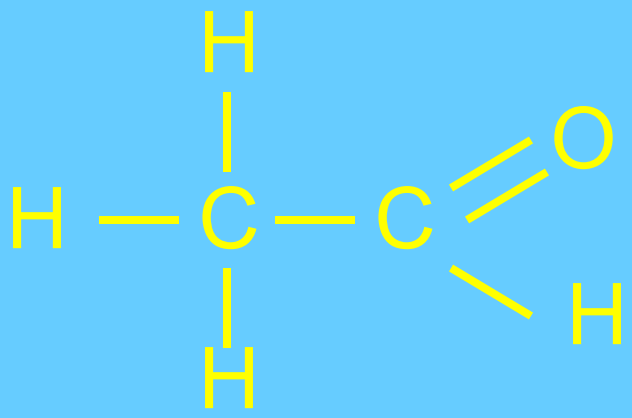


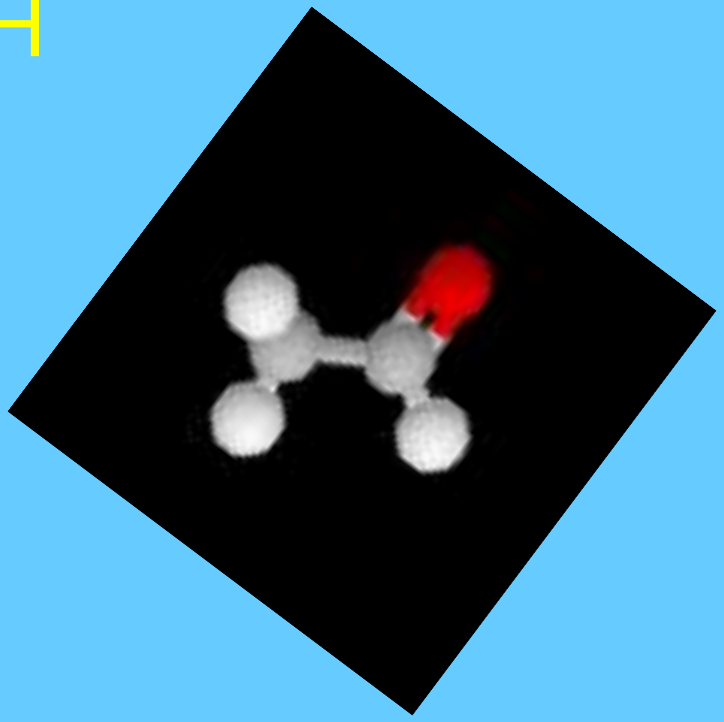
Ethanal (acetaldehyde): a two-carbon aldehyde.

- Alcohols can be oxidized to aldehydes



Draw ethanal





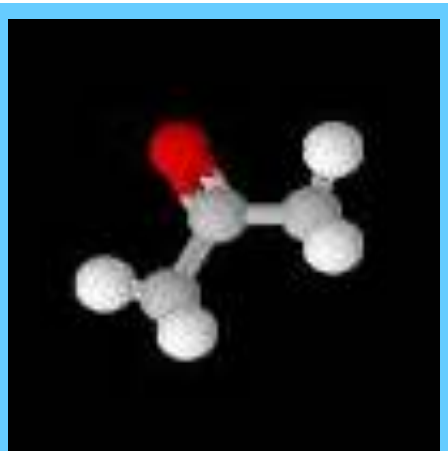
Ketones – contain the functional group R-CO-R

- Replace the final "e" with "-one".

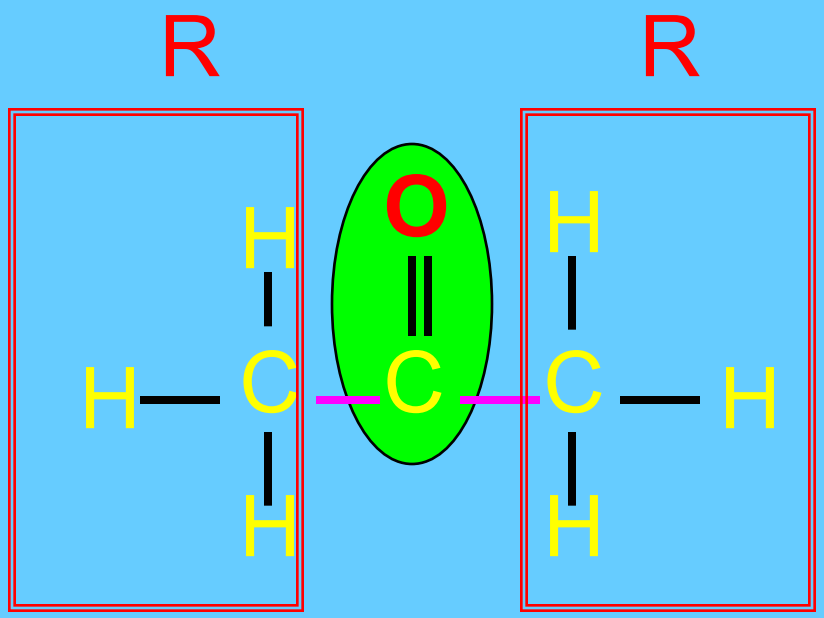
Table R
Organic Functional Groups

Class of Compound	Functional Group	General Formula	Example
ketone	$-\overset{\overset{\large O}{\|\|}}{C}-$	$R-\overset{\overset{\large O}{\|\|}}{C}-R'$	$CH_3\overset{\overset{\large O}{\|\|}}{C}CH_2CH_2CH_3$ 2-pentanone

- The simplest member of the ketone family is propanone.



- IUPAC name is propanone but its common name is acetone, it is an important industrial solvent.



Ethers -

- when two primary alcohols are treated with a dehydrating agent, water is removed and the 2 alcohols are joined together by an oxygen "bridge".

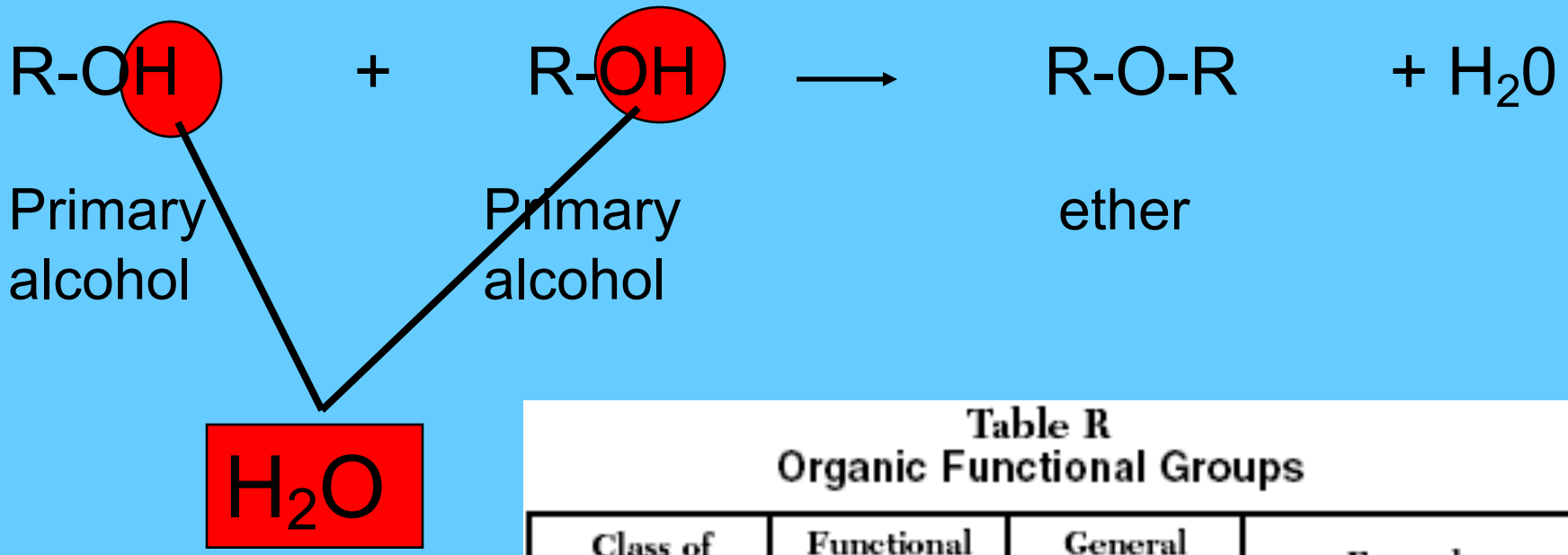
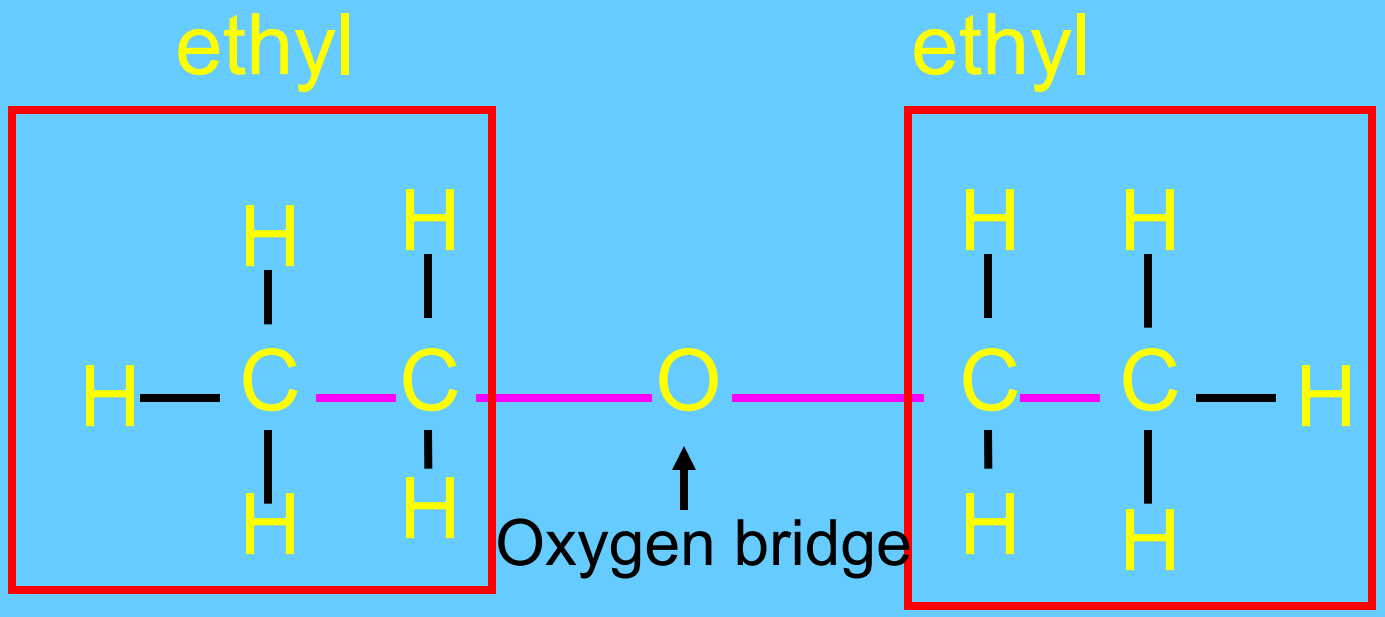


Table R
Organic Functional Groups

Class of Compound	Functional Group	General Formula	Example
ether	—O—	$R—O—R'$	$CH_3OCH_2CH_3$ methyl ethyl ether

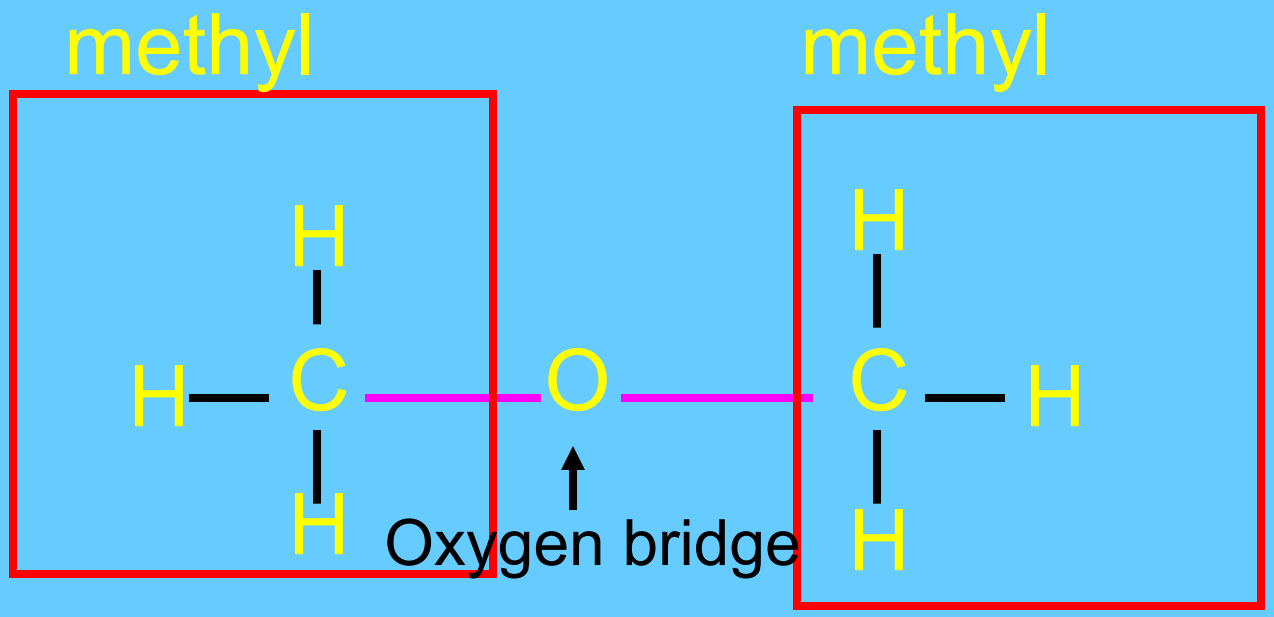
Diethyl ether- used as a general anesthetic



Condensed formula

$CH_3\ CH_2\text{-O-}\ CH_2CH_3$

Dimethyl ether-



Condensed formula

CH_3-O- CH_3

Name These:

Condensed formula

CH_3-O- CH_2CH_3

Methyl ethyl ether

CH_3CH_2-O- $CH_2CH_2CH_3$

Ethyl propyl ether

Esters – are organic cmpds with the general formula *R*-CO-O-*R*

They are formed in a rxn between an organic acid and an alcohol.

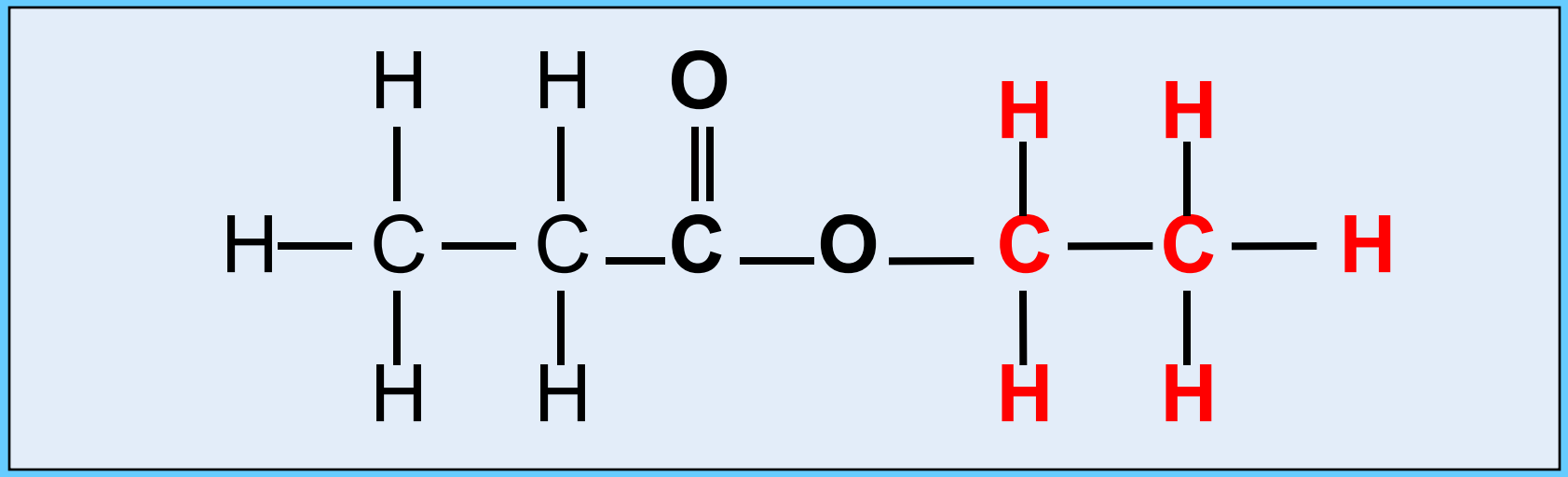
O

C O

Draw this:

Esters have strong fragrant aromas and are what make pineapples, bananas, wintergreen & oranges so YummY!

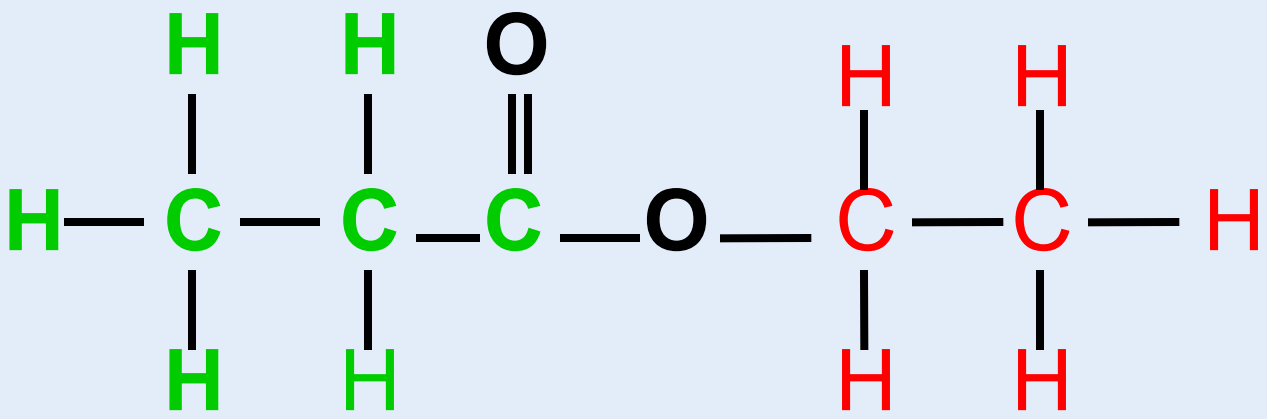
IUPAC naming of Esters:



1. Look at chain after the –C(=O)-O- write its prefix

Ex.(meth,eth, etc.) and add –yl to the end of prefix

In this ex. : eth + yl = ethyl



Condensed formula

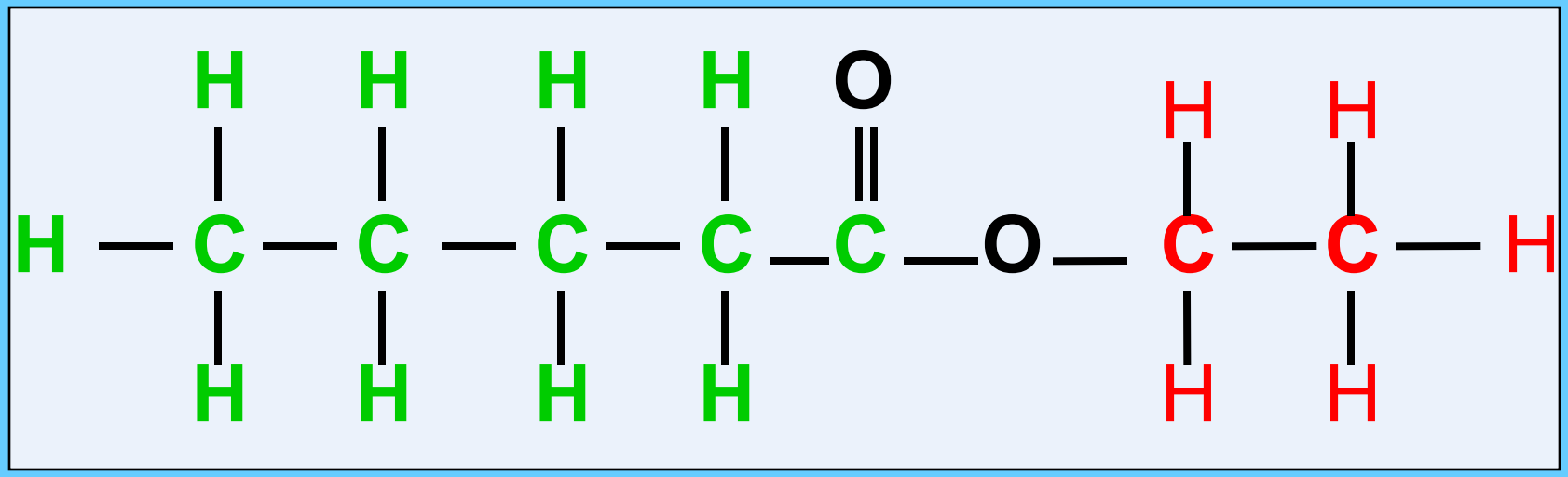
$CH_3\,CH_2\,COO\,CH_2CH_3$

2. Give the name of the carbon chain that includes the C=O, leave off the last letter and add –oate. **Propane**

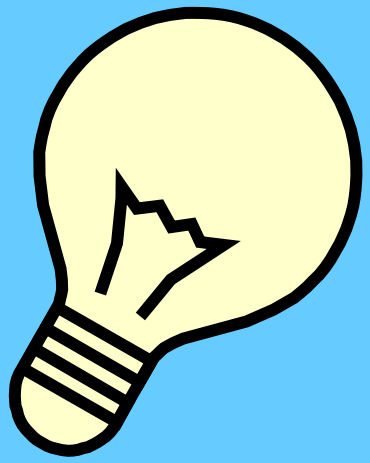
propane + oate = propanoate

Ethyl propanoate

Ex.) Draw ethyl pentanoate



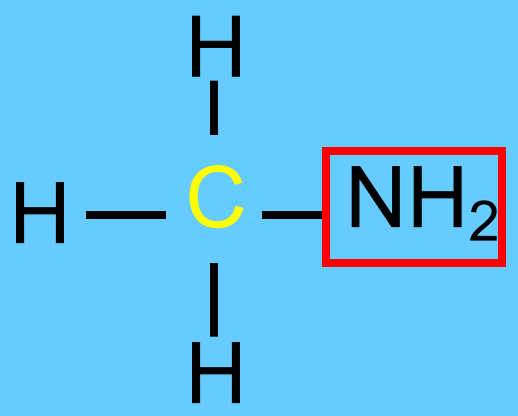
Now you've got it!



Amines – contain the functional group **-N-**

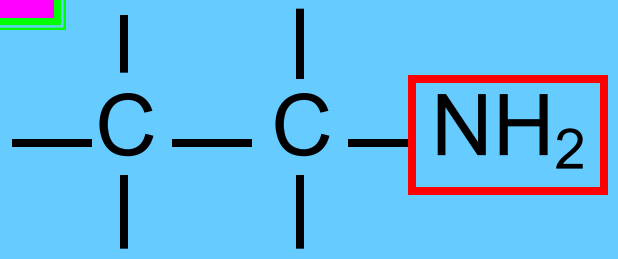
- It is a derivative of ammonia – NH_3
- IUPAC naming of amines –

  - replace the final –e with "-amine"



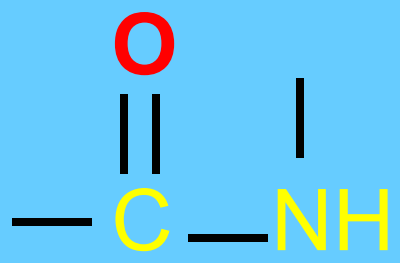
methanamine

Draw:



ethanamine

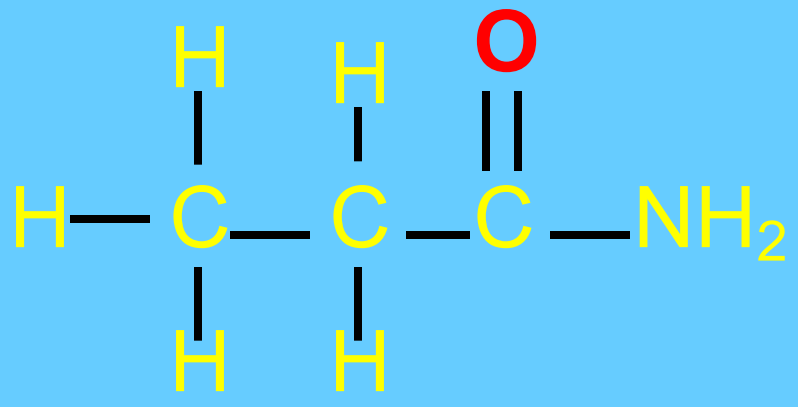
Amides – contain the functional group:



Found at the end of a carbon chain

- IUPAC naming of amides:

  -drop the final –e and add "amide"

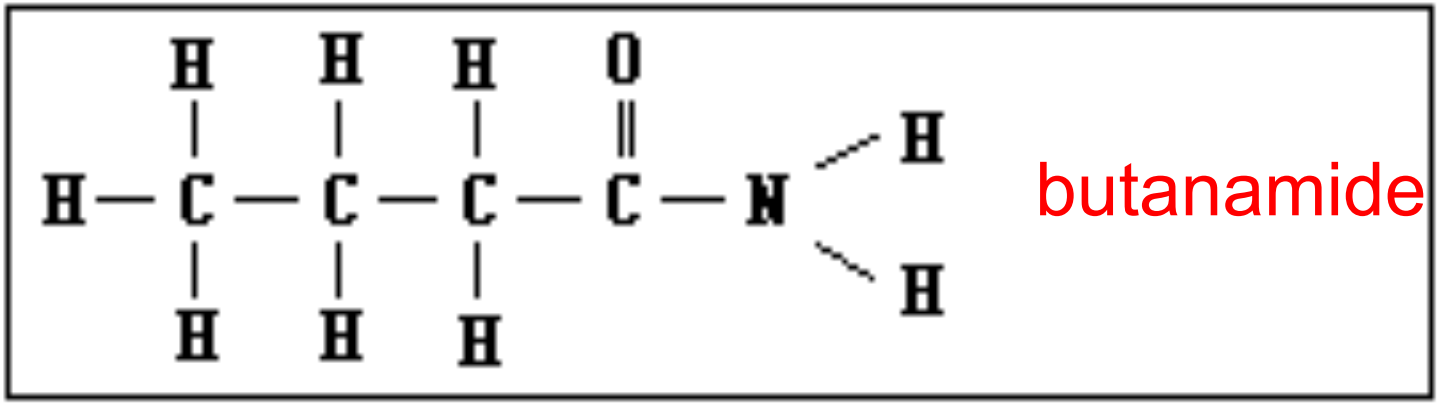


propanamide

Amide

Table R
Organic Functional Groups

Class of Compound	Functional Group	General Formula	Example
amide	$-\overset{\overset{\large O}{\|}}{C}-\overset{\overset{\large \|}{}}{N}H$	$R-\overset{\overset{\large O}{\|}}{C}-\overset{\overset{\large R'}{\|}}{N}H$	$CH_3CH_2\overset{\overset{\large O}{\|}}{C}-NH_2$ propanamide



butanamide

Synthetic Polyamides: nylon, kevlar

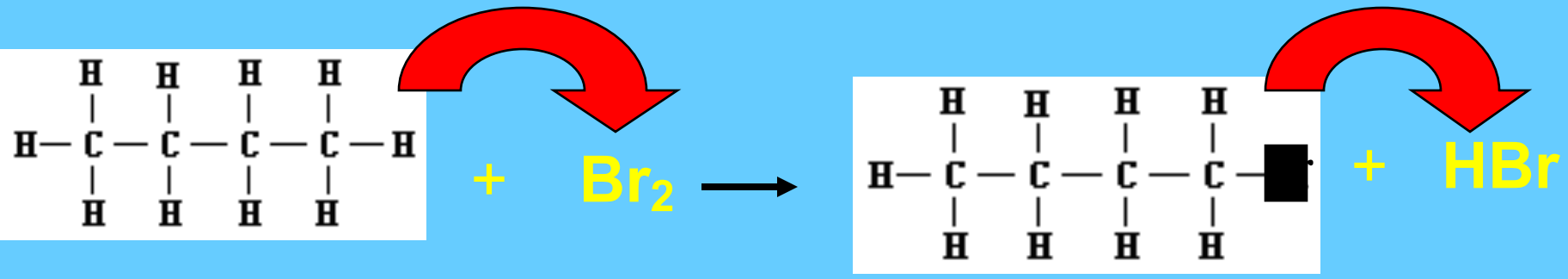
Natural Polyamide: silk!

Organic Reactions

- Substitution – **replacement** of one kind of atom or group with another atom or group
  - If this rxn occurs between an **alkane** and a **halogen**, it is called **halogenation**.

*only happens with alkanes – single bonds!!!!

Substitution



Butane + bromine → Bromobutane + Hydrogen bromide

$C_4H_{10} + Br_2 \rightarrow C_4H_9Br + HBr$

The second Br can then substitute for another H.

$C_3H_7F + HF$

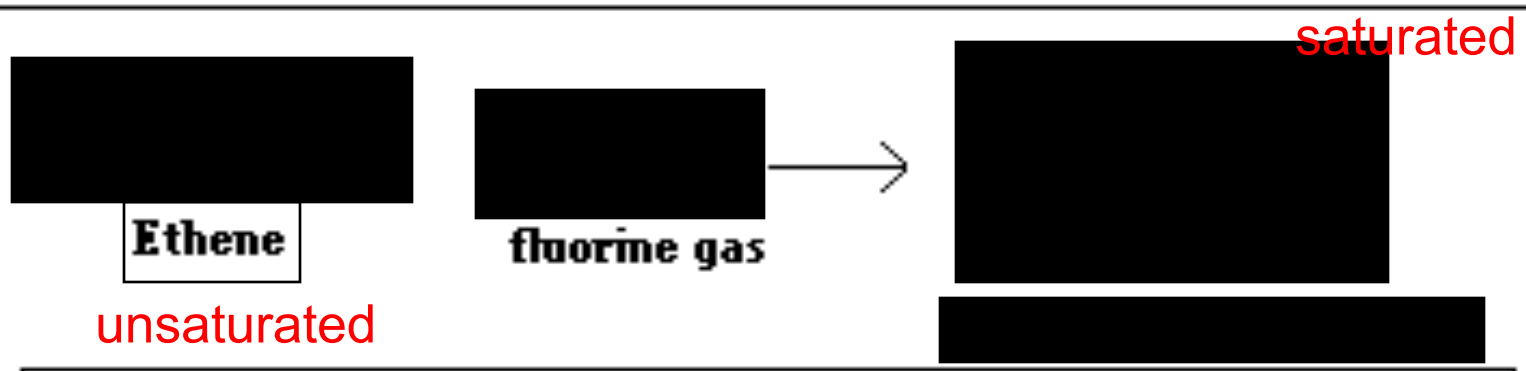
Addition –adding one or more groups at a double or triple bond.

- Double bond is broken…becomes a **single** bond.

*only happens with alkenes & alkynes – double/triple bonds!!!!

Addition

- Alkene + Halogen → Alkyl Halide
- The double bond is broken, and the halogen adds at either side of where the double bond was.



The fluorine atoms have a choice: to replace hydrogen or break the double bond. They will do whatever takes less energy to do, and in this case, breaking one of the double bonds takes less energy. Because each bond in a double bond is "stretched", each one has slightly less strength than a normal single bond. It is easier to break one of the C=C bonds than to break a C-H bond. When the double bond breaks down to a single bond, it frees up one electron in each carbon to form another bond. The fluoring atoms ADD to the site of the double broken bond, one on one carbon, one on the other.

Fermentation

-**Molecules are broken down**

- **enzymes act as catalysts**

-**Anaerobic respiration**

$$C_6H_{12}O_6 \xrightarrow{\text{zymase}} 2\,CH_3CH_2OH + 2\,CO_2$$

glucose ⟶ ethanol + Carbon dioxide

Esterification

- **Organic Acid + Alcohol → Ester + Water**

-COOH **-OH** **-COO** **-H_2O**

-These are slow reversible reactions

-similar to neutralization rxn in inorganic

Acid + base = +

Saponification – is the hydrolysis of fats by **bases**.

- The breaking of an ester to produce an organic acid plus an alcohol.

(glycerol ester) (soap) (alcohol)

Fat + water = organic acid + glycerol

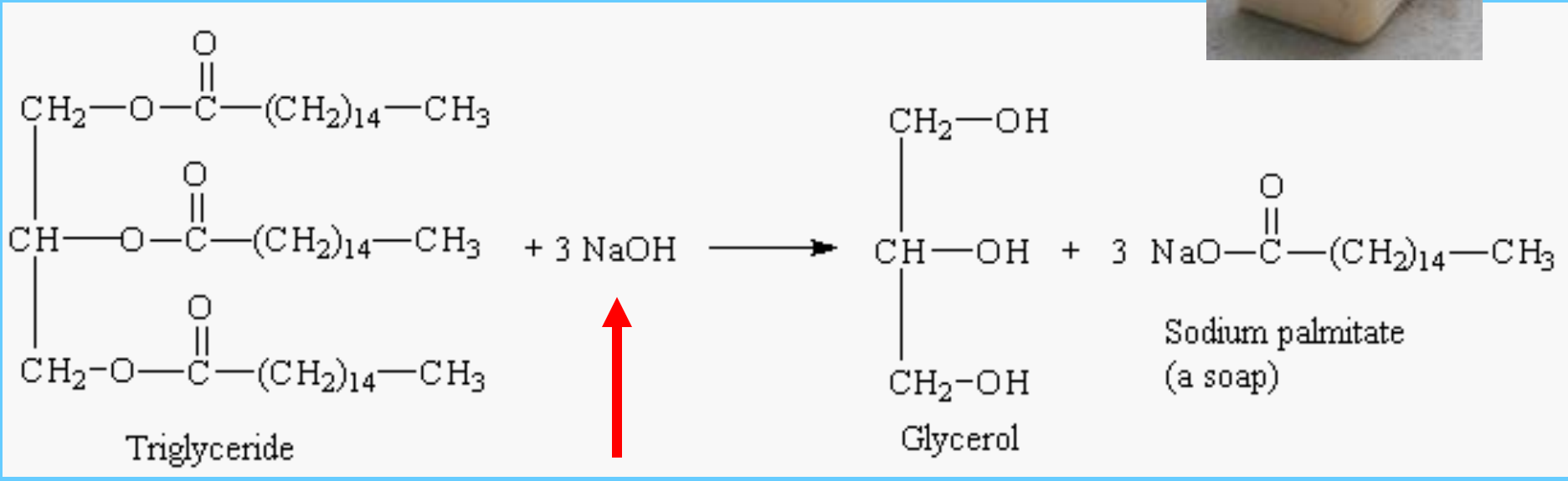
What is this the reverse process of?

Esterification

Organic Acid + Alcohol → Ester + Water

Saponification - hydrolysis of an ester in presence of a hot base (alkali)

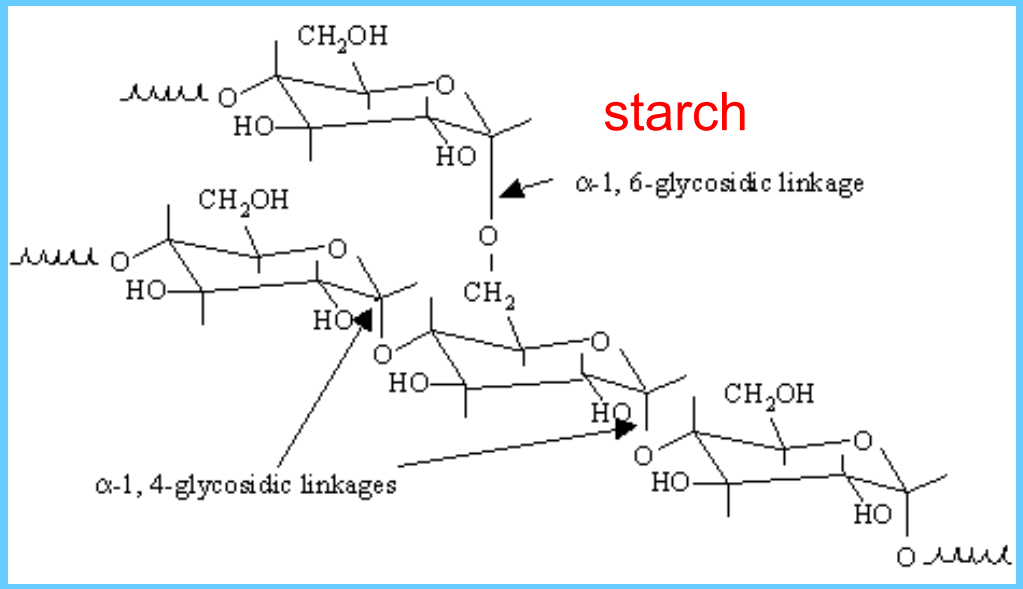
Glycerol ester + 3 NaOH → soap + glycerol



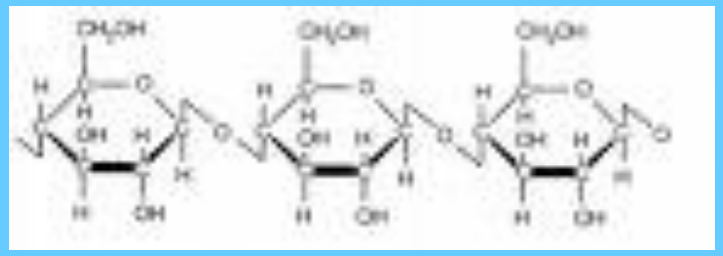
Fat **base** **alcohol** **soap**

Polymers- are composed of many repeating units of **monomers**

- Natural polymers
  - -starch – long chains of sugars
  - -proteins – long chains of amino acids
  - -cellulose – made of repeating units of sugar



cellulose



Polymers

- <u>Synthetic (man made) polymers:</u>

- nylon, rayon

- polyester

- **polyethylene**

- silicone

Polymerization- formation of polymers from **monomers**

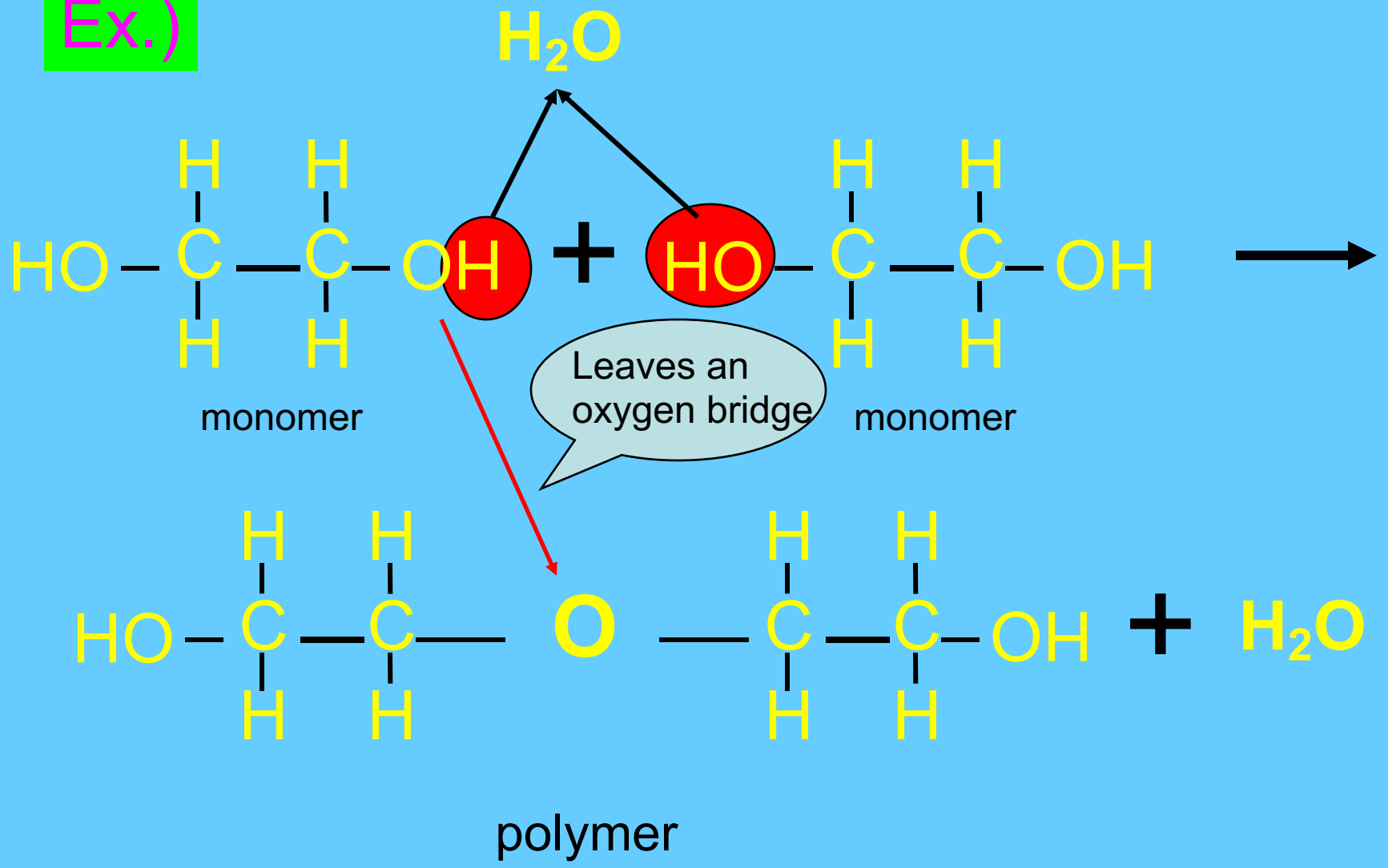
- Formation of larger molecules from smaller

2 Methods :

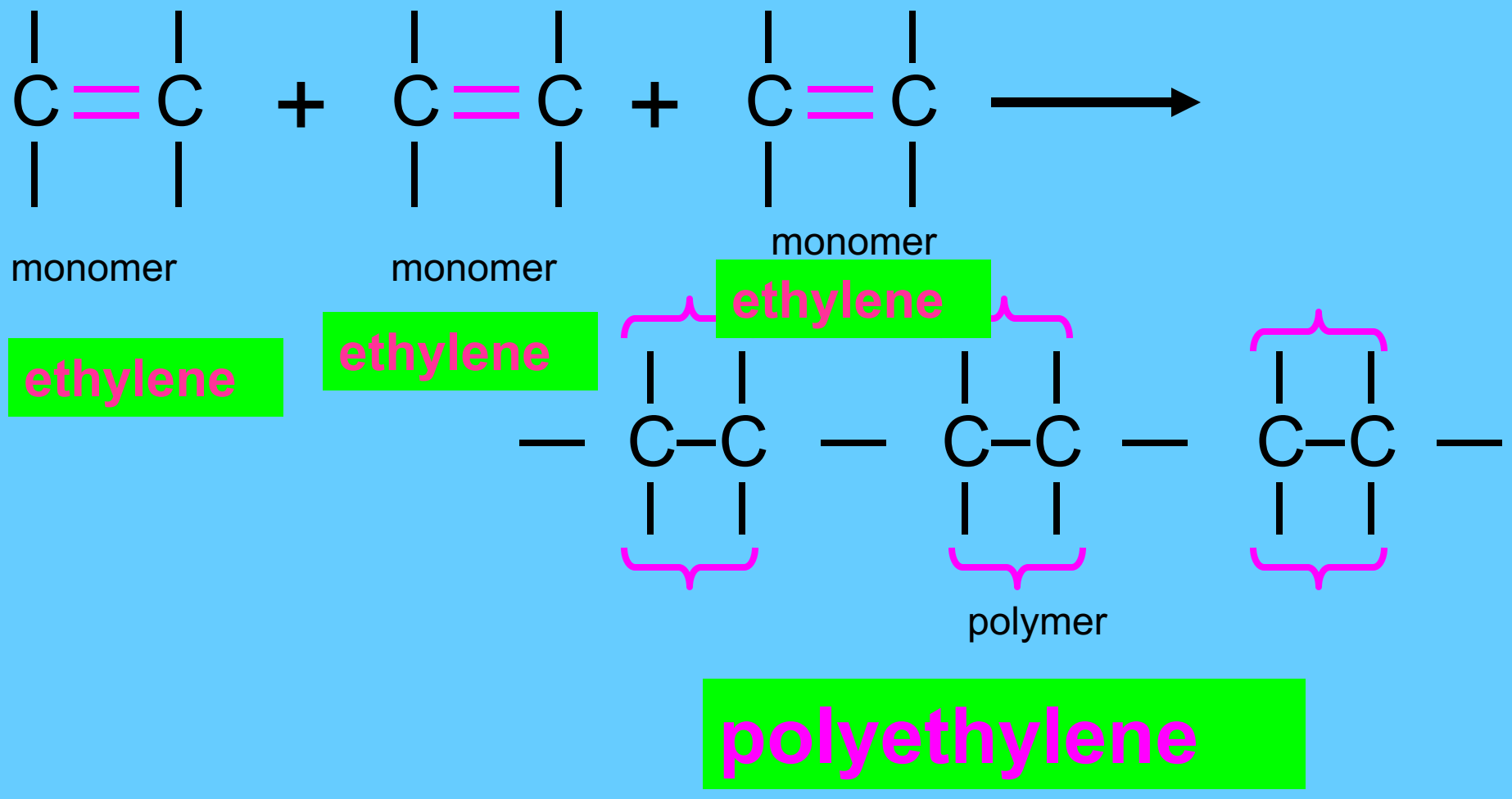
1. Condensation polymerization: bonding of monomers by dehydration synthesis
   - Monomers have at least two functional groups
   - -OH on ends

Condensation polymerization

Ex.)



Addition Polymerization -



Finding missing reactants & products in organic rxns

- In balanced rxns the number of atoms on the left must equal the number of atoms on the right. Ex.) $C_2H_6 + Cl_2 \longrightarrow C_2H_5Cl +$ _____

Left side	Right side	missing
C = 2	C = 2	C = 0
H = 6	H = 5	H = 1
Cl = 2	Cl = 1	Cl = 1

⇨ Missing product must be HCl

⇨ This is a substitution rxn because hydrogen atom of ethane is replaced by chlorine.

- Try this one: Ex.) $C_2H_4 + Br_2 \longrightarrow C_2H_4Br_2$

This is a addition rxn

- What process makes…

fermentation

saponification

combustion

Condensation polymerization

addition polymerization