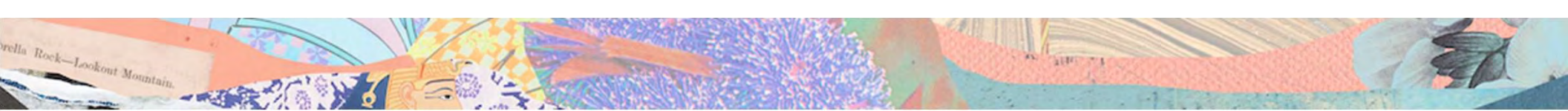


La chimie du... par le cidre!

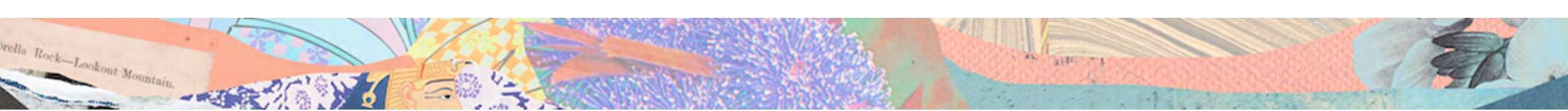
par Émile Robert, M. Sc. en chimie
dans le cadre du congrès
Cidres, vins et alcools d'ici
Le 16 mars 2023



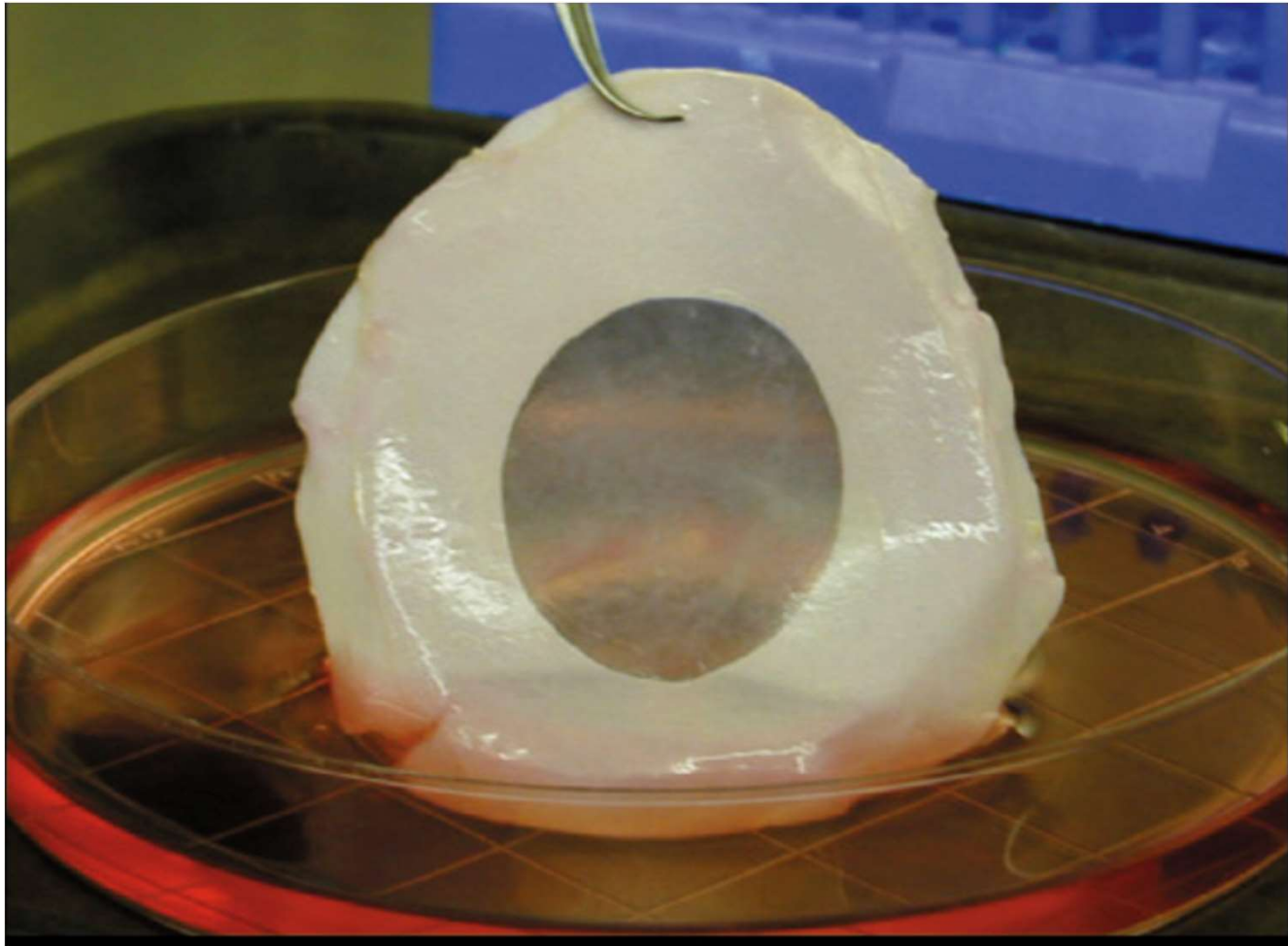


Introduction





Introduction



Introduction

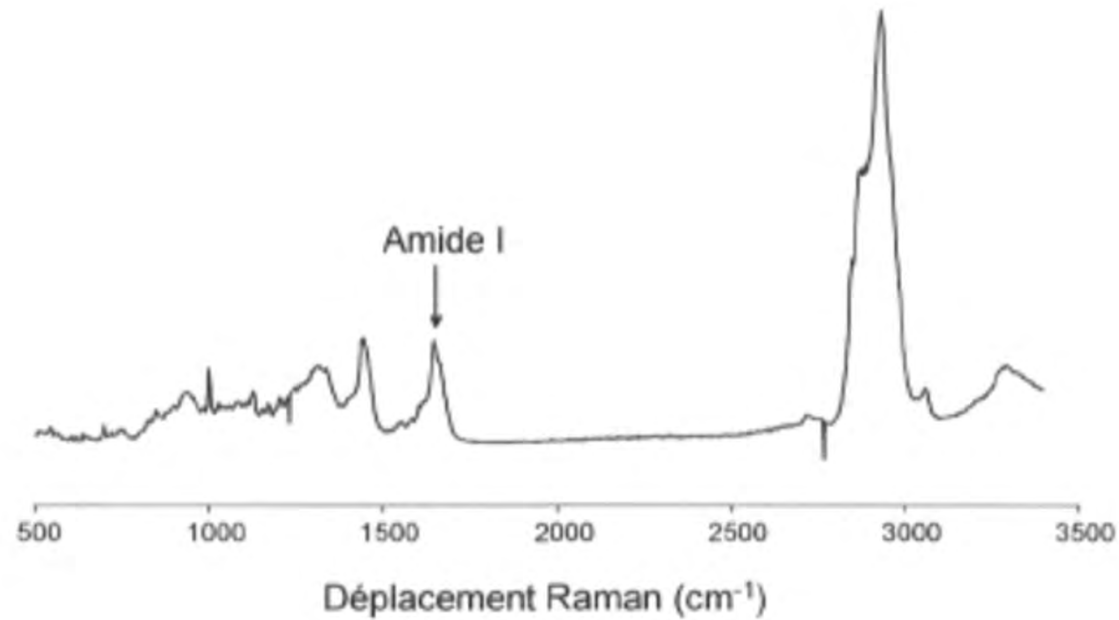
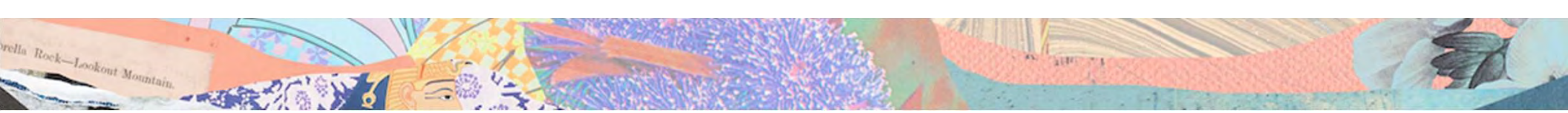
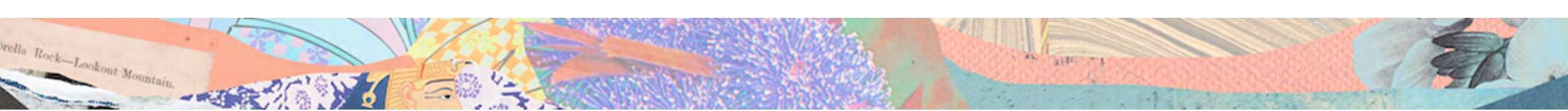


Figure 2.3 : Exemple de spectre obtenu en spectroscopie Raman pour la couche cornée d'un substitut sain produit par la méthode d'auto-assemblage.



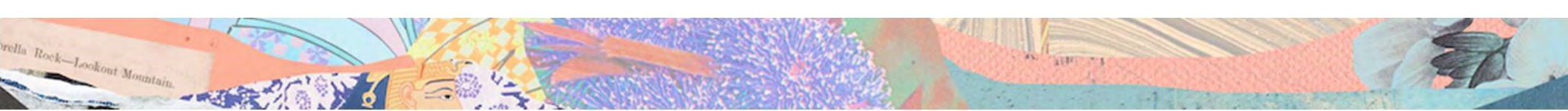
Introduction



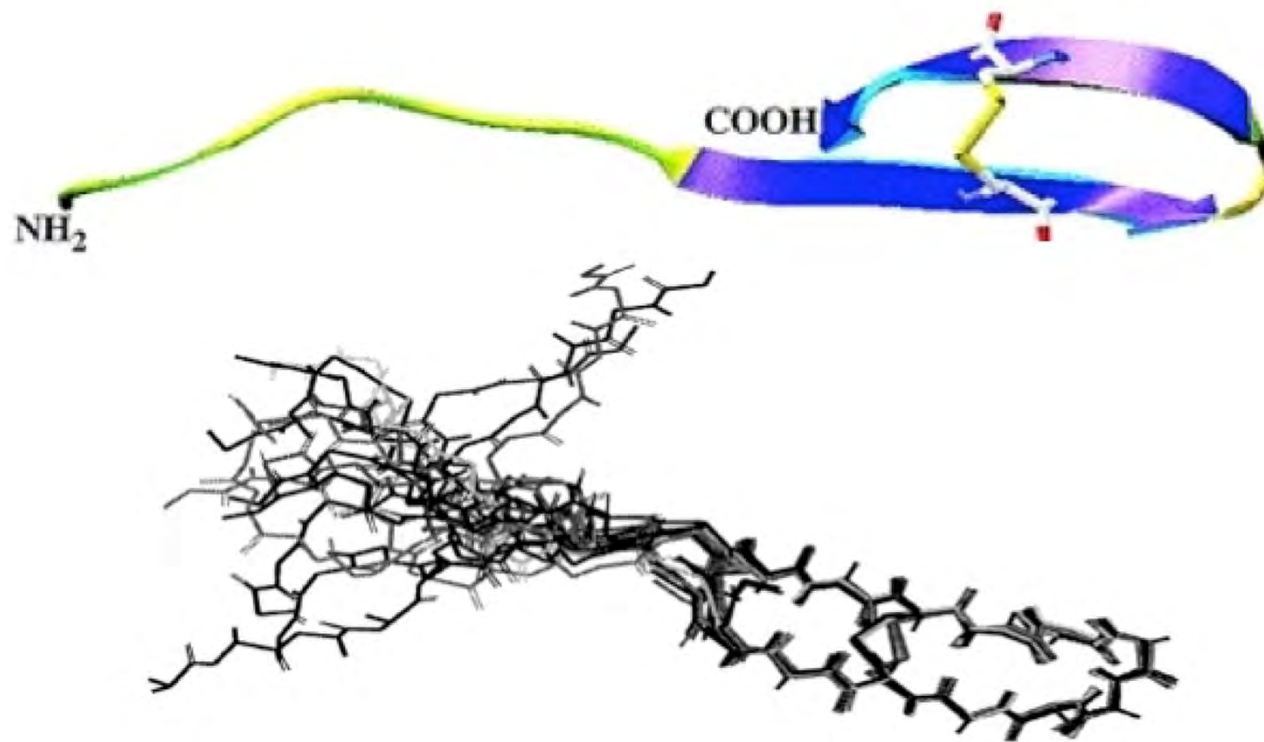


Introduction

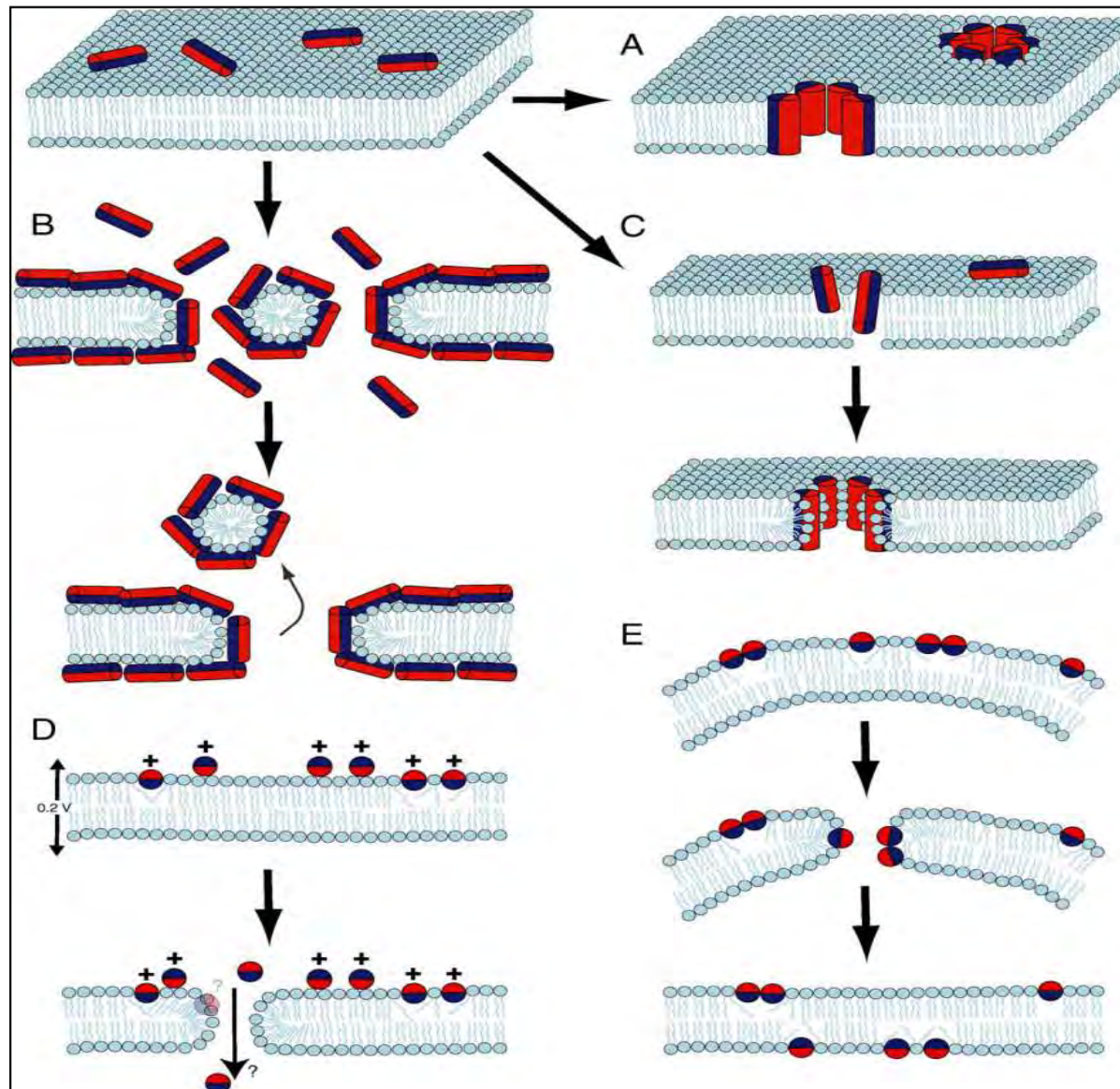




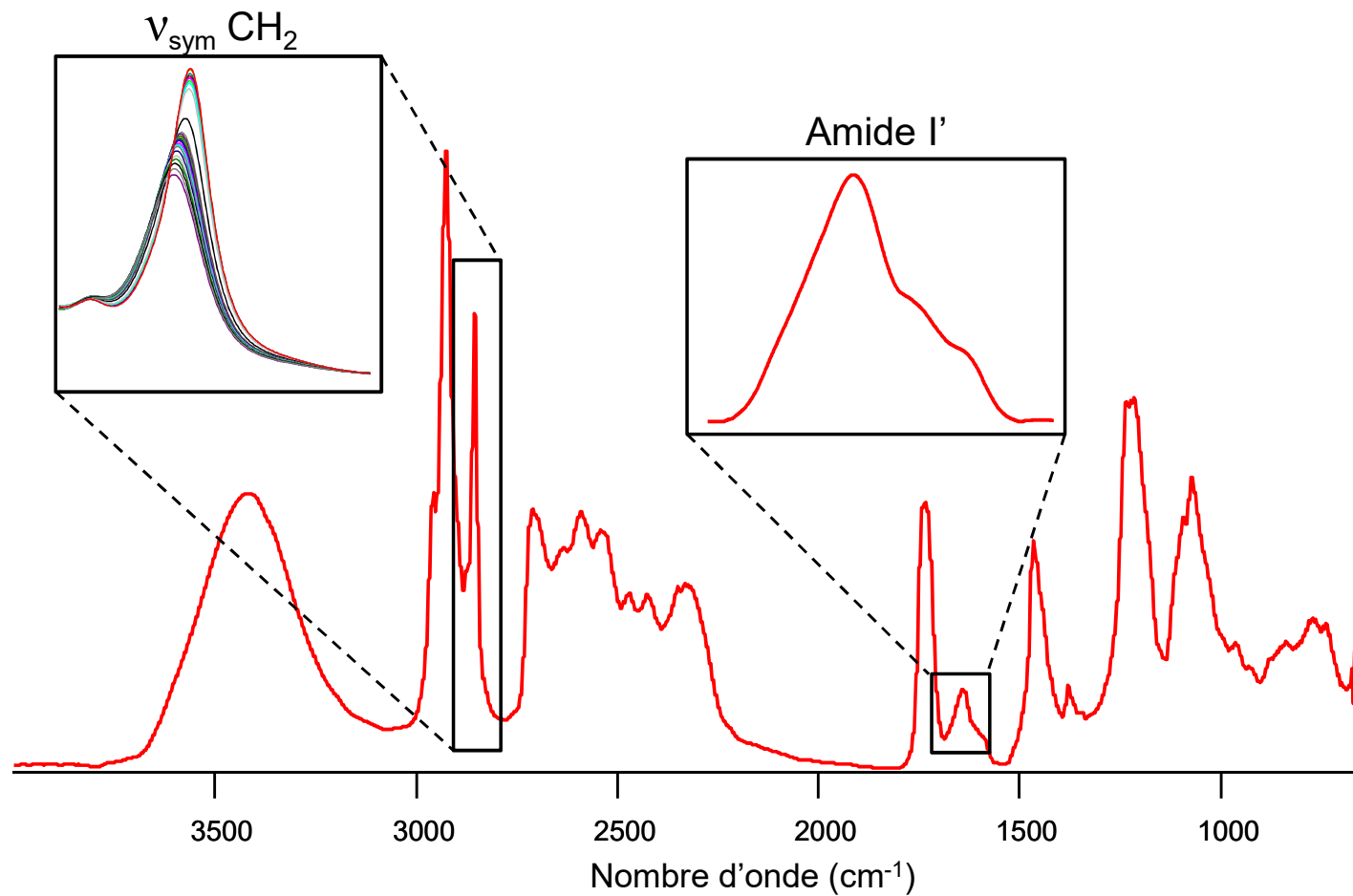
Introduction

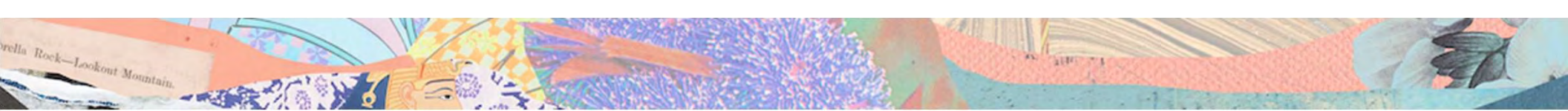


Introduction



Introduction

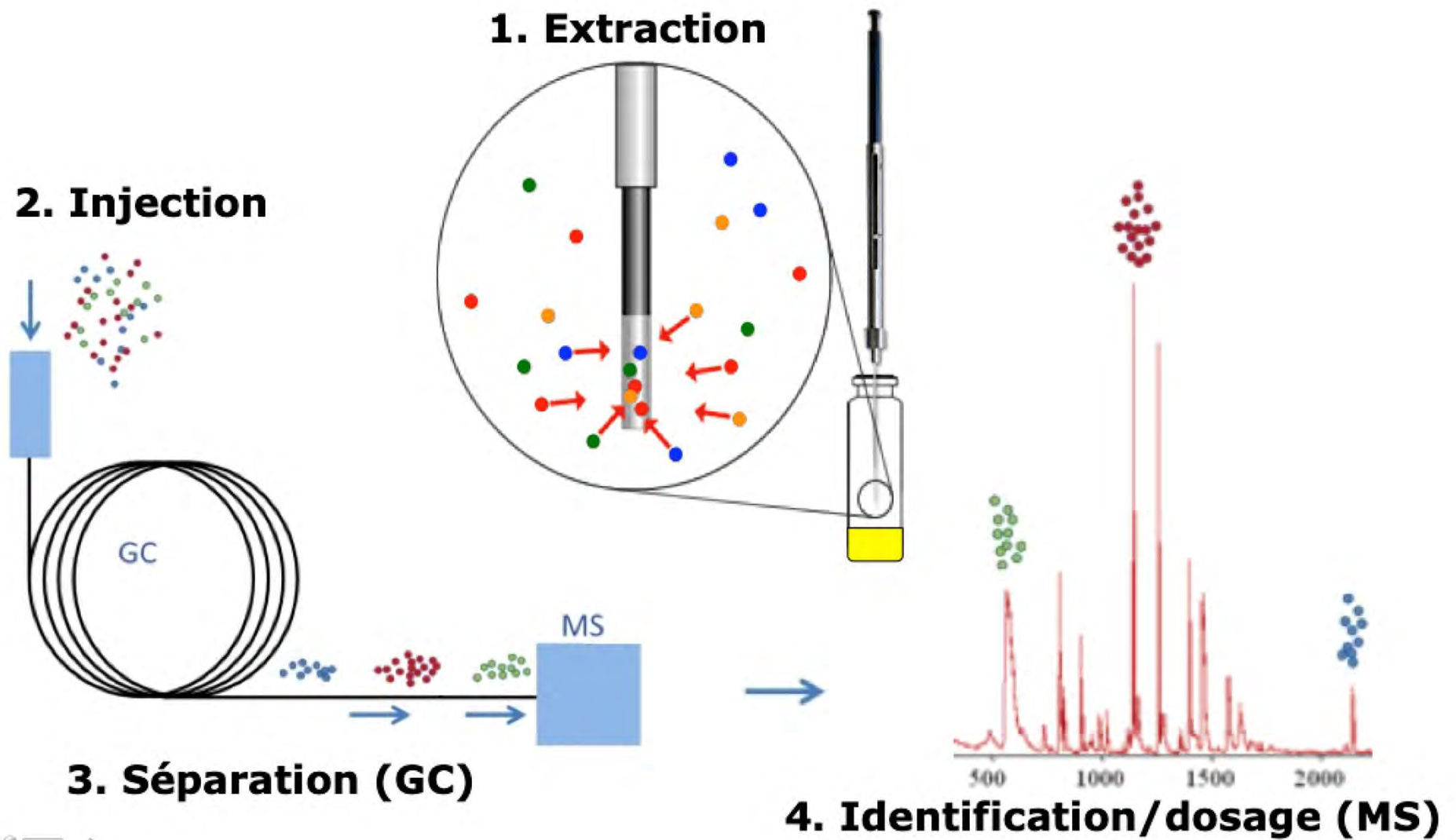




Introduction

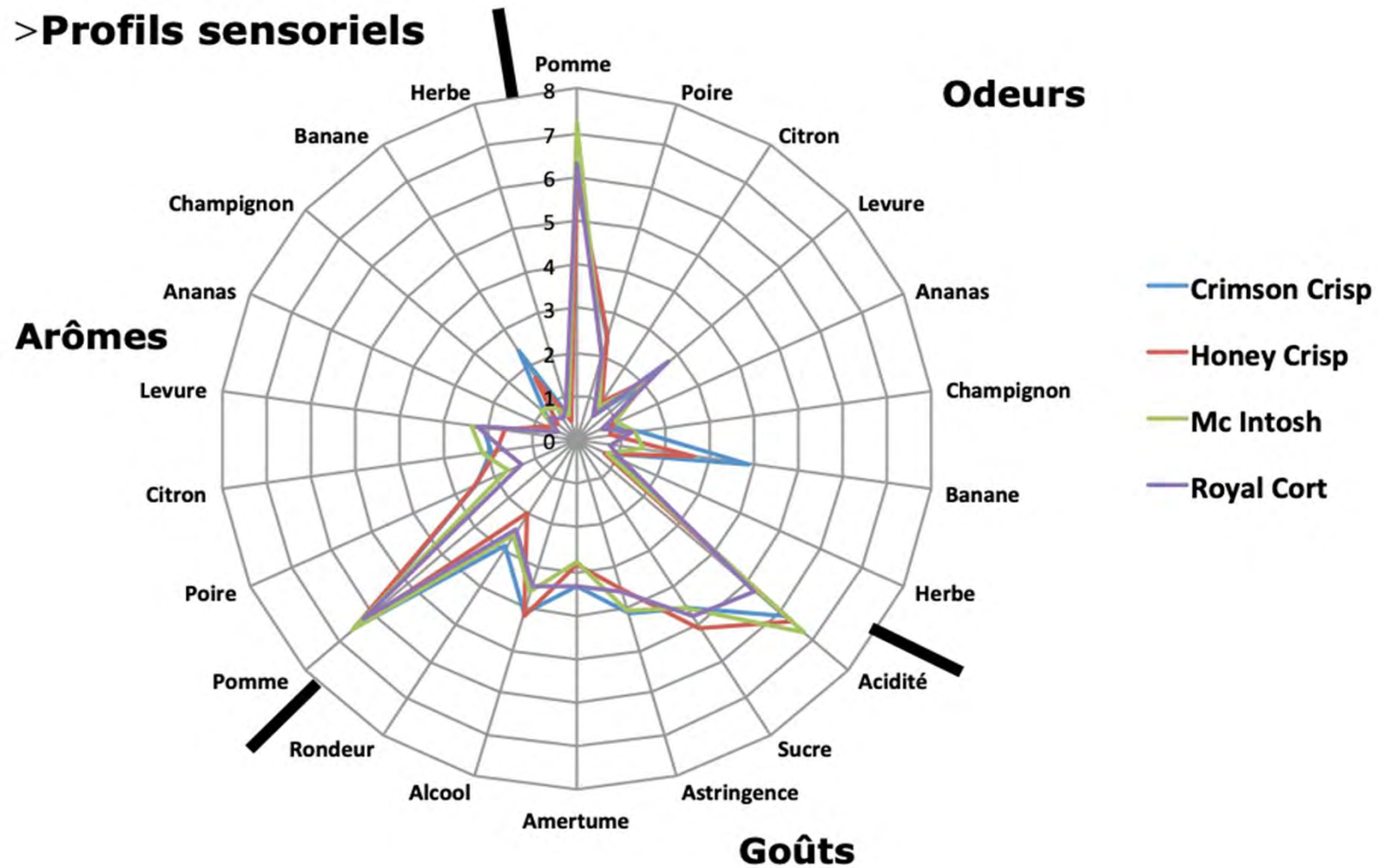


Introduction



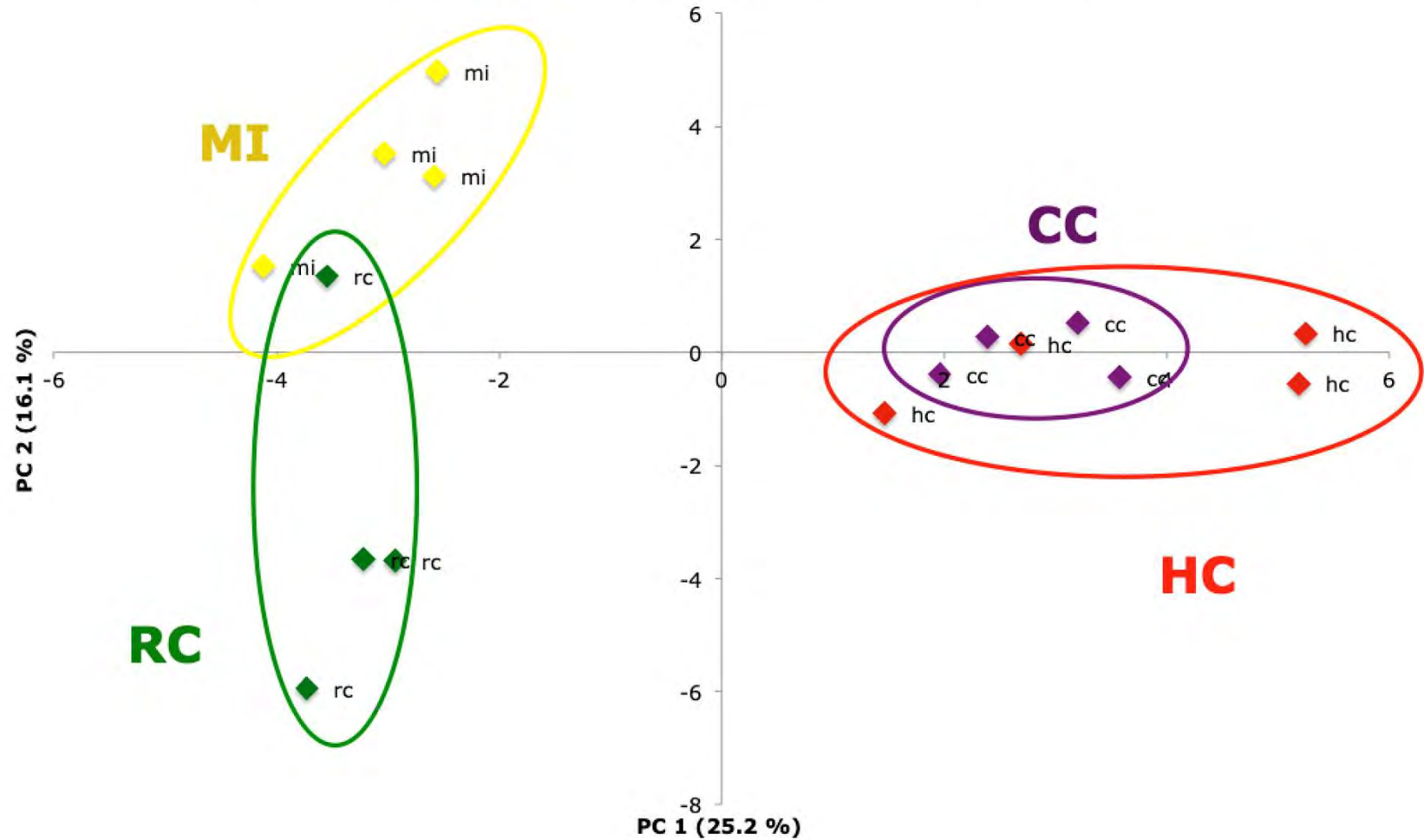
Introduction

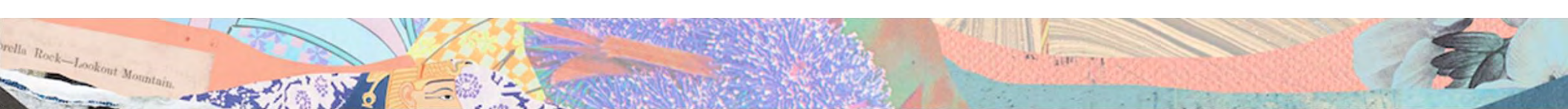
> Profils sensoriels



Introduction

> Analyse en composantes primaires (PCA)





Objectif de la mission

Avec le cidre comme point
de départ :

- Vulgariser la chimie, la physique, la biochimie et les sciences
- S'émerveiller devant la nature avec laquelle nous travaillons
 - Piquer votre curiosité!



Objectif de la mission



La chimie c'est...



Société des alcools du Québec
7500, rue Tellier
Montréal, Qc H1N 3W5
Tél. 514-254-6000 poste 6149
Courriel: qualite.info@saq.qc.ca

Certificat d'analyses / Certificate of Analysis
Laboratoire
LAPT-0002138-01
Version: 1

Délivré à / Issued to:

Gestion de la Qualité
SAQ
7500 rue Tellier
Montréal, Québec

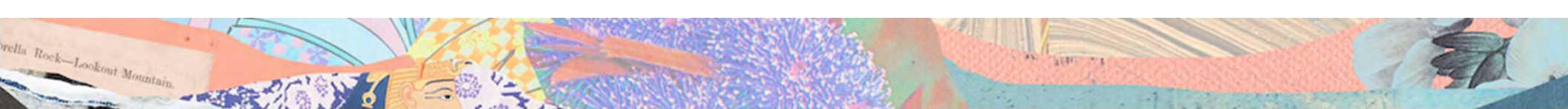
Client / Customer:

EMILE ROBERT
VIGNOBLE ET VERGER CASA BRETON
270, CHEMIN JEAN-GUÉRIN OUEST
ST-HENRI, Québec

Remarques et conclusion d'expertise

Échantillon du produit fini (embouteillé) : Les résultats de l'analyse chimique sont conformes.

Paramètres / Parameters	Résultats / Result	Unités / Units	Date d'analyse / Date analyzed	No méthode / Method code	Accrédité * / Accredited *
Acidité totale / Total acidity	3.6	g H2SO4/L	2021-05-13	102	Oui / Yes
Acidité volatile / Volatile acidity	0.31	g H2SO4/L	2021-05-13	103	Oui / Yes
Sucres réducteurs / Reducing sugars	1.7	g/L	2021-05-13	104	Oui / Yes
Anhydride sulfureux libre / Free sulfur dioxide	<5.0	mg/L	2021-05-13	105	Oui / Yes
Anhydride sulfureux total / Total sulfur dioxide	<5.0	mg/L	2021-05-13	106	Oui / Yes



Les éléments

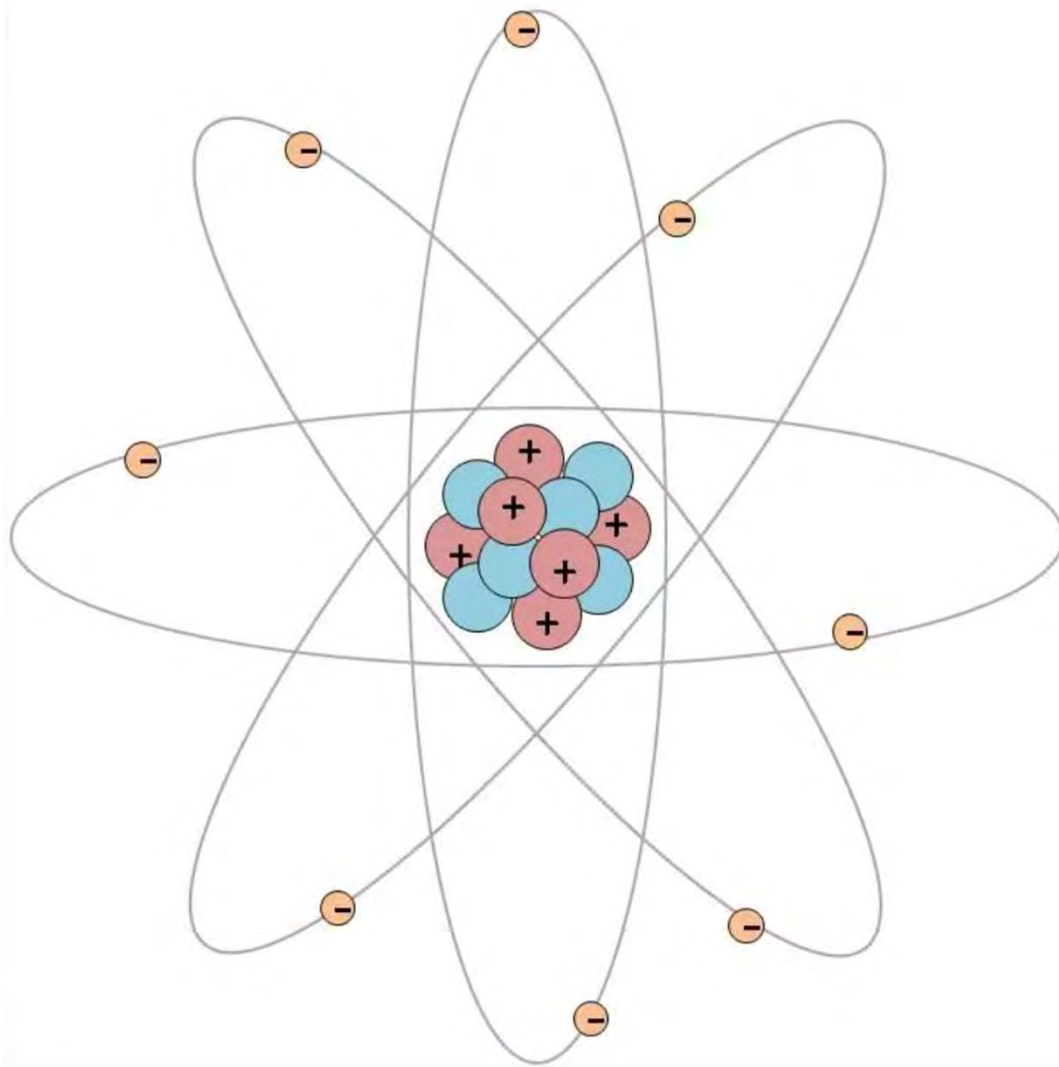
As- Arsenic	<0.020	mg/L
Cd- Cadmium	<0.010	mg/L
Cu - Cuivre / Copper	<0.10	mg/L
Fe - Fer / Iron	<1.0	mg/L
K - Potassium	890	mg/L
Mn - Manganèse / Manganese	0.32	mg/L
Na - Sodium	<20	mg/L
Pb - Plomb / Lead	<0.010	mg/L
Zn - Zinc	0.12	mg/L



Tableau périodique des éléments chimiques

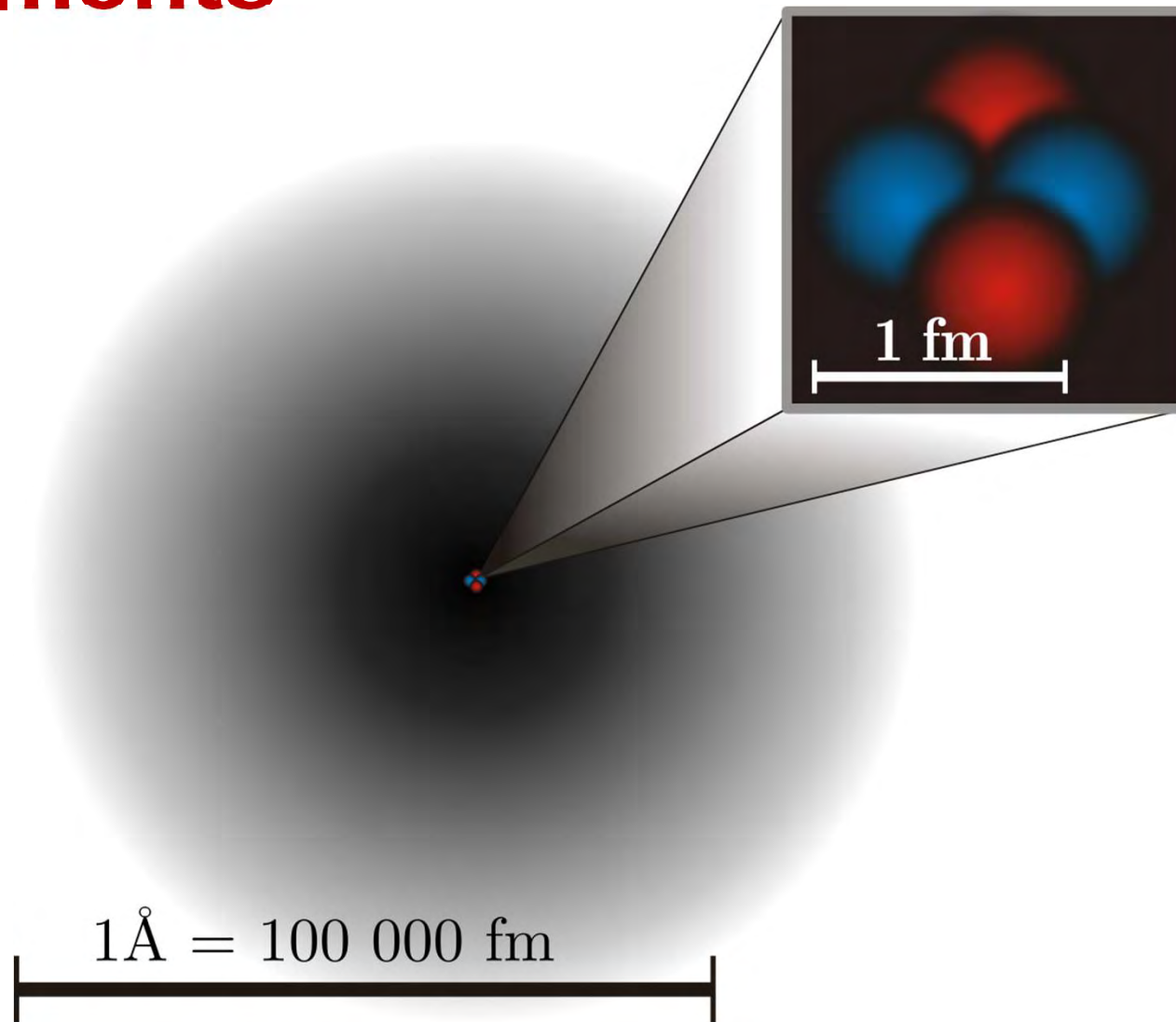
Groupe		Tableau périodique des éléments chimiques																VIII A	
Période		18																	
1	I A																	II A	
1																			
2																			
3																			
4																			
5																			
6																			
7																			
8																			
9																			
10																			
11																			
12																			
13																			
14																			
15																			
16																			
17																			
18																			
19																			
20																			
21																			
22																			
23																			
24																			
25																			
26																			
27																			
28																			
29																			
30																			
31																			
32																			
33																			
34																			
35																			
36																			
37																			
38																			
39																			
40																			
41																			
42																			
43																			
44																			
45																			
46																			
47																			
48																			
49																			
50																			
51																			
52																			
53																			
54																			
55																			
56																			
57																			
58																			
59																			
60																			
61																			
62																			
63																			
64																			
65																			
66																			
67																			
68																			
69																			
70																			
71																			
72																			
73																			
74																			
75																			
76																			
77																			
78																			
79																			
80																			
81																			
82																			
83																			
84																			
85																			
86																			
87																			
88																			
89																			
90																			
91																			
92																			
93																			
94																			
95																			
96																			
97																			
98																			
99																			
100																			
101																			
102																			
103																			
104																			
105																			
106																			
107																			
108																			
109																			
110																			
111																			
112																			
113																			
114																			
115																			
116																			
117																			
118																			
119																			
120																			
121																			
122																			
123																			
124																			
125																			
126																			
127																			
128																			
129																			
130																			
131																			
132																			
133																			
134																			
135																			
136																			
137																			
138																			
139																			
140																			
141																			
142																			
143																			
144																			
145																			
146																			
147																			
148																			
149																			
150																			
151																			
152																			
153																			
154																			
155																			
156																			
157																			
158																			
159																			
160																			
161																			
162																			
163																			
164																			
165																			
166																			
167																			
168																			
169																			
170																			
171																			
172																			
173																			
174																			
175																			
176																			
177																			
178																			
179																			
180																			
181																			
182																			
183																			
184																			
185																			
186																			
187																			
188																			
189																			
190																			
191																			
192																			
193																			
194																			
195																			
196																			
197																			
198																			
199																			
200																			
201																			
202																			
203																			
204																			
205																			
206																			
207																			
208																			
209																			
210																			
211																			
212																			
213																			
214																			
215																			
216																			
217																			
218																			
219																			
220																			
221																			
222																			
223																			
224																			
225																			
226																			
227																			
228																			
229																			
230																			
231																			
232																			
233																			
234																			
235																			
236																			
237																			
238																			
239																			
240																			
241																			
242																			
243																			
244																			
245																			
246																			
247																			
248																			
249																			
250																			
251																			
252																			
253																			
254																			
255																			
256																			
257																			
258																			
259																			
260																			
261																			
262																			
263																			
264																			
265																			
266																			
267																			
268																			
269																			
270																			
271																			
272																			
273																			
274																			
275																			
276																			
277																			
278																			
279																			
280																			
281																			
282																			
283																			
284																			
285																			
286																			
287																			
288																			
289																			
290																			
291																			
292																			
293																			
294																			
295																			
296																			
297																			
298																			
299																			
300																			
301																			
302																			
303																			
304																			
305																			
306																			
307																			
308																			
309																			
310																			
311																			
312																			
313																			
314																			
315																			
316																			
317																			
318																			
319																			
320																			
321																			
322																			
323																			
324																			
325																			
326																			
327																			
328																			
329																			
330																			
331																			
332																			
333																			
334																			
335																			
336																			
337																			
338																			
339																			
340																			
341																			
342																			
343																			
344																			
345																			
346																			
347																			
348																			
349																			
350																			
351																			
352																			
353																			
354																			
355																			
356																			
357																			
358																			
359																			
360																			
361																			
362																			
363																			
364																			
365																			
366																			
367																			
368																			
369																			
370																			
371																			
372																			
373																			
374																			
375																			
376																			
377																			
378																			
379																			
380																			
381																			
382																			
383																			
384																			
385																			
386																			
387																			
388																			
389																			
390																			
391																			
392																			
393																			
394																			
395																			
396																			
397																			
398																			
399																			
400		</																	

Les éléments

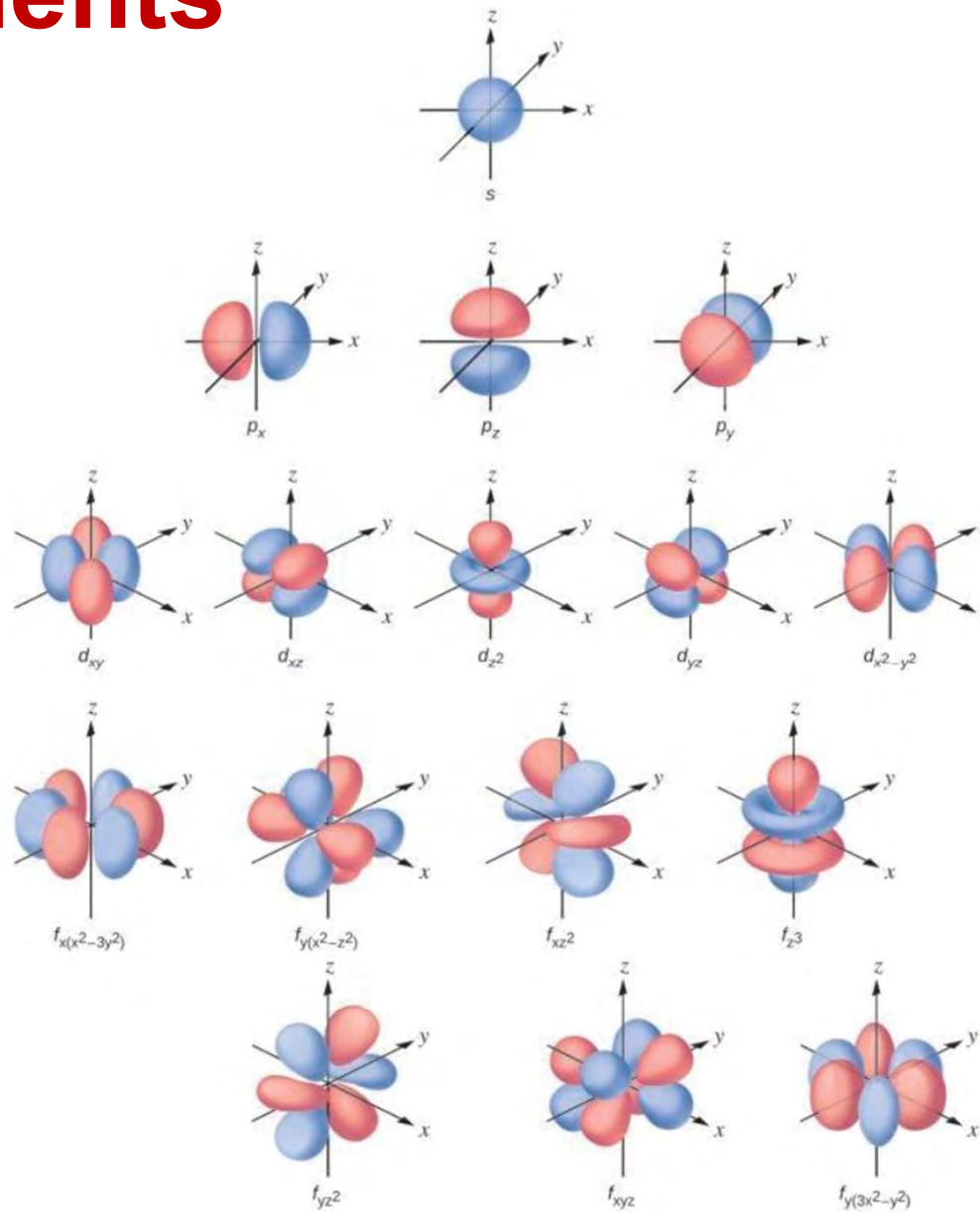


- protons
 - neutrons
 - électrons
 - trajectoire des électrons
- } nucléons

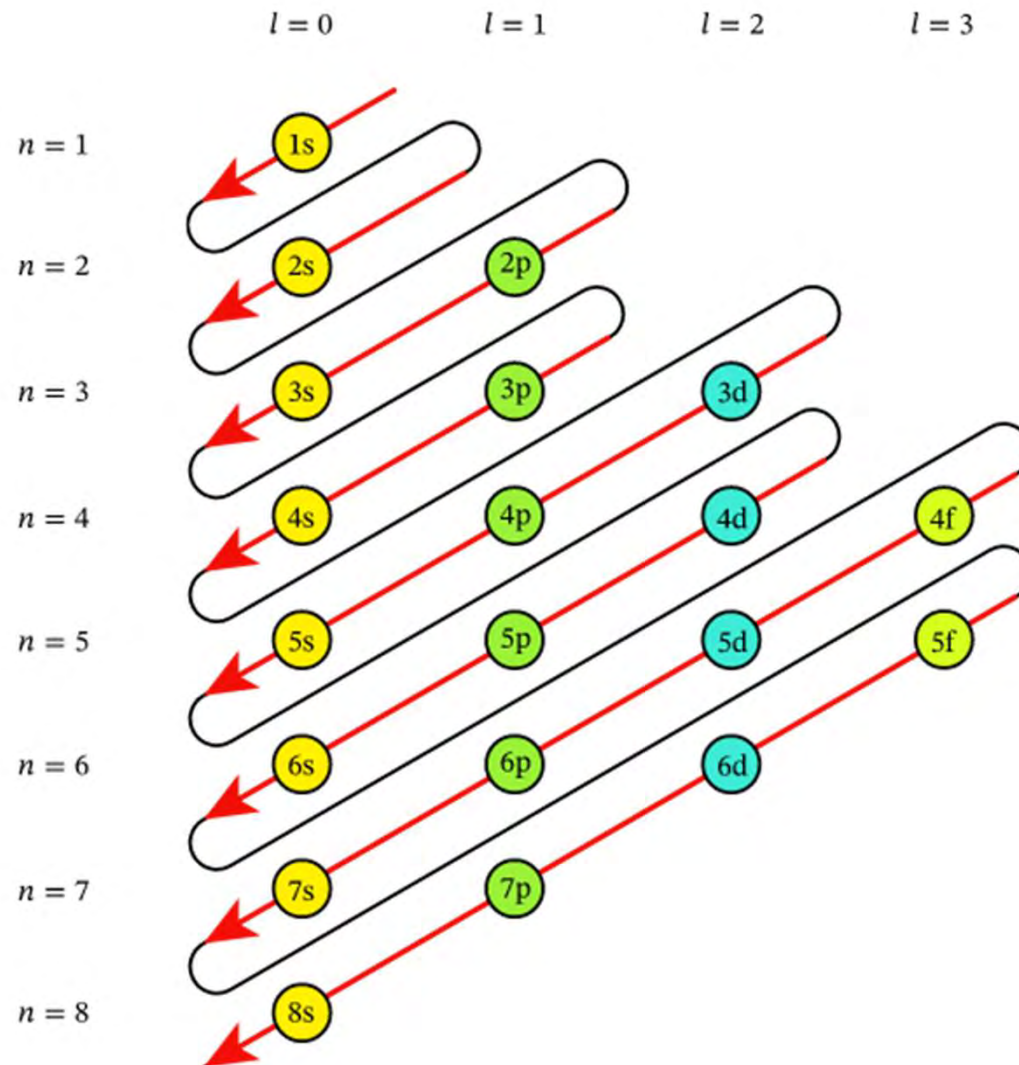
Les éléments



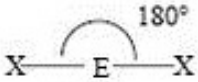
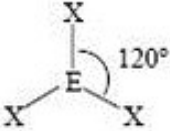
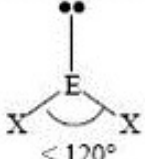
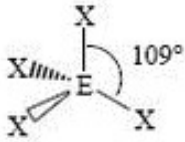
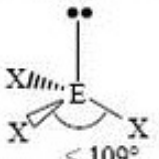
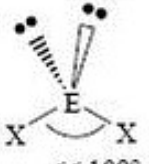
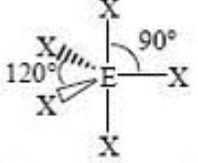
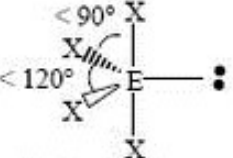
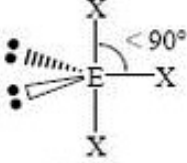
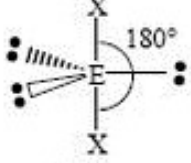
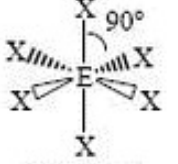
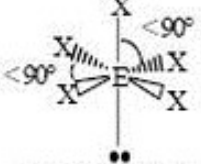
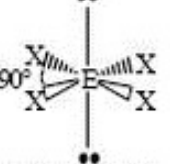
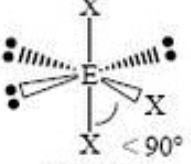
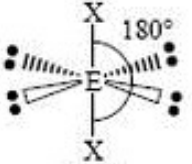
Les éléments



Les éléments



Les éléments

VSEPR Geometries					
Steric No.	Basic Geometry 0 lone pair	1 lone pair	2 lone pairs	3 lone pairs	4 lone pairs
2	 Linear				
3	 Trigonal Planar	 Bent or Angular			
4	 Tetrahedral	 Trigonal Pyramid	 Bent or Angular		
5	 Trigonal Bipyramid	 Sawhorse or Seesaw	 T-shape	 Linear	
6	 Octahedral	 Square Pyramid	 Square Planar	 T-shape	 Linear

Les éléments

Tableau périodique des éléments chimiques

Groupe	I A	II A	III A	IV A	V A	VI A	VII A	VIII	IX	X	XI	II B	III B	IV B	V B	VI B	VII B	VIII A
Période	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	Hydrogène 1 H 1,007975																	Hélium 2 He 4,002602
2	Lithium 3 Li 6,9395	Béryllium 4 Be 9,0121831											Bore 5 B 10,8135	Carbone 6 C 12,0106	Azote 7 N 14,006855	Oxygène 8 O 15,99940	Fluor 9 F 18,99840316	Néon 10 Ne 20,1797 (6)
3	Sodium 11 Na 22,98976928	Magnésium 12 Mg 24,3055											Aluminium 13 Al 26,9815385	Silicium 14 Si 28,085 (1)	Phosphore 15 P 30,97376200	Soufre 16 S 32,0675	Chlore 17 Cl 35,4515	Argon 18 Ar 39,948 (1)
4	Potassium 19 K 39,0983 (1)	Calcium 20 Ca 40,078 (4)	Scandium 21 Sc 44,955908 (5)	Titane 22 Ti 47,867 (1)	Vanadium 23 V 50,9415 (1)	Chrome 24 Cr 51,9961 (6)	Manganèse 25 Mn 54,938044	Fer 26 Fe 55,845 (2)	Cobalt 27 Co 58,933194	Nickel 28 Ni 58,6934 (4)	Cuivre 29 Cu 63,546 (3)	Zinc 30 Zn 65,38 (2)	Gallium 31 Ga 69,723 (1)	Germanium 32 Ge 72,630 (8)	Arsenic 33 As 74,921595	Sélénium 34 Se 78,971 (8)	Brome 35 Br 79,904	Krypton 36 Kr 83,798 (2)
5	Rubidium 37 Rb 85,4678 (3)	Strontium 38 Sr 87,62 (1)	Yttrium 39 Y 88,90584	Zirconium 40 Zr 91,224 (2)	Niobium 41 Nb 92,90637	Molybdène 42 Mo 95,95 (1)	Technétium 43 Tc [98]	Ruthénium 44 Ru 101,07 (2)	Rhodium 45 Rh 102,90550	Palladium 46 Pd 106,42 (1)	Argent 47 Ag 107,8682 (2)	Cadmium 48 Cd 112,414 (4)	Indium 49 In 114,818 (1)	Étain 50 Sn 118,710 (7)	Antimoine 51 Sb 121,760 (1)	Tellure 52 Te 127,60 (3)	Iode 53 I 126,90447	Xénon 54 Xe 131,293 (6)
6	Césium 55 Cs 132,905452	Baryum 56 Ba 137,327 (7)	Lanthanides 57-71	Hafnium 72 Hf 178,49 (2)	Tantale 73 Ta 180,94788	Tungstène 74 W 183,84 (1)	Rhénium 75 Re 186,207 (1)	Osmium 76 Os 190,23 (3)	Iridium 77 Ir 192,217 (3)	Platine 78 Pt 195,084 (9)	Or 79 Au 196,966569	Mercur 80 Hg 200,592 (3)	Thallium 81 Tl 204,3835	Plomb 82 Pb 207,2 (1)	Bismuth 83 Bi 208,98040	Polonium 84 Po [209]	Astate 85 At [210]	Radon 86 Rn [222]
7	Francium 87 Fr [223]	Radium 88 Ra [226]	Actinides 89-103	Rutherfordium 104 Rf [267]	Dubnium 105 Db [268]	Seaborgium 106 Sg [269]	Bohrium 107 Bh [270]	Hassium 108 Hs [277]	Meitnérium 109 Mt [278]	Darmstadtium 110 Ds [281]	Roentgenium 111 Rg [282]	Copernicium 112 Cn [285]	Nihonium 113 Nh [286]	Flerovium 114 Fl [289]	Moscovium 115 Mc [289]	Livermorium 116 Lv [293]	Tennesse 117 Ts [294]	Oganesson 118 Og [294]
				Lanthane 57 La 138,90547	Cérium 58 Ce 140,116 (1)	Praséodyme 59 Pr 140,90766	Néodyme 60 Nd 144,242 (3)	Prométhium 61 Pm [145]	Samarium 62 Sm 150,36 (2)	Europium 63 Eu 151,964 (1)	Gadolinium 64 Gd 157,25 (3)	Terbium 65 Tb 158,92535	Dysprosium 66 Dy 162,500 (1)	Holmium 67 Ho 164,93033	Erbium 68 Er 167,259 (3)	Thulium 69 Tm 168,93422	Ytterbium 70 Yb 173,045	Lutécium 71 Lu 174,9668
				Actinium 89 Ac [227]	Thorium 90 Th 232,0377	Protactinium 91 Pa 231,03588	Uranium 92 U 238,02891	Neptunium 93 Np [237]	Plutonium 94 Pu [244]	Américium 95 Am [243]	Curium 96 Cm [247]	Berkélium 97 Bk [247]	Californium 98 Cf [251]	Einsteinium 99 Es [252]	Fermium 100 Fm [257]	Mendélévium 101 Md [258]	Nobélium 102 No [259]	Lawrencium 103 Lr [266]

← nom de l'élément (**gaz**, **liquide** ou **solide** à 0°C et 101,3 kPa)
 ← numéro atomique
 ← symbole chimique
 ← masse atomique relative [ou celle de l'isotope le plus stable]
 [CIAAW "Atomic Weights 2013"
 + rev. 2015]

Métaux

Alcalins

Alcalino-terreux

Lanthanides

Actinides

Métaux de transition

Métaux pauvres

Métalloïdes

Non métaux

Autres non-métaux

Halogènes

Gaz nobles

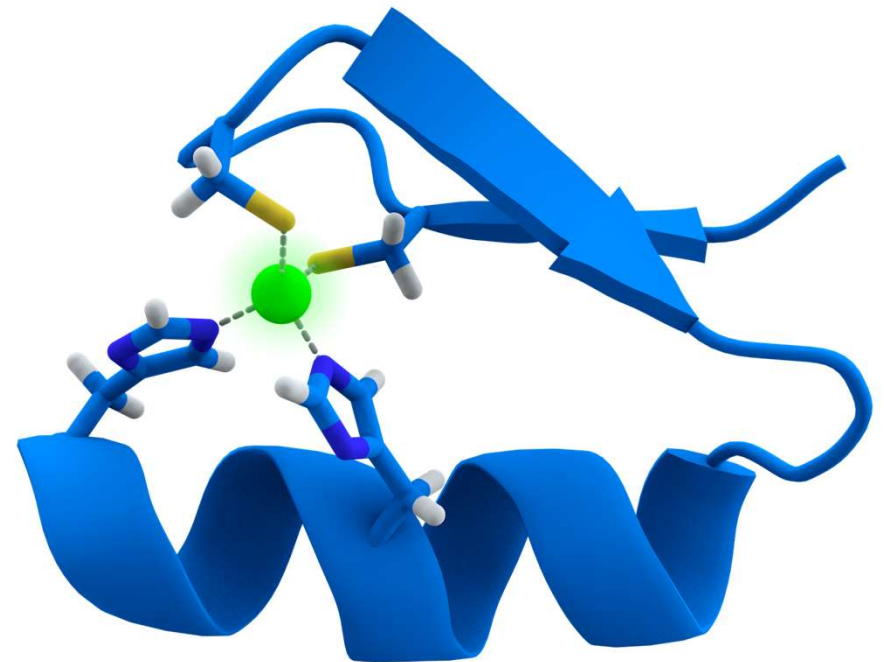
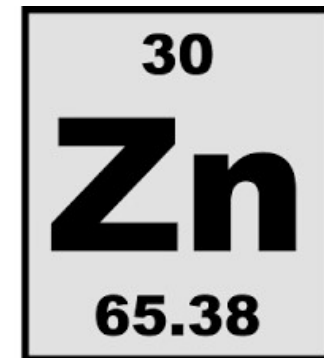
Non classés

primordial

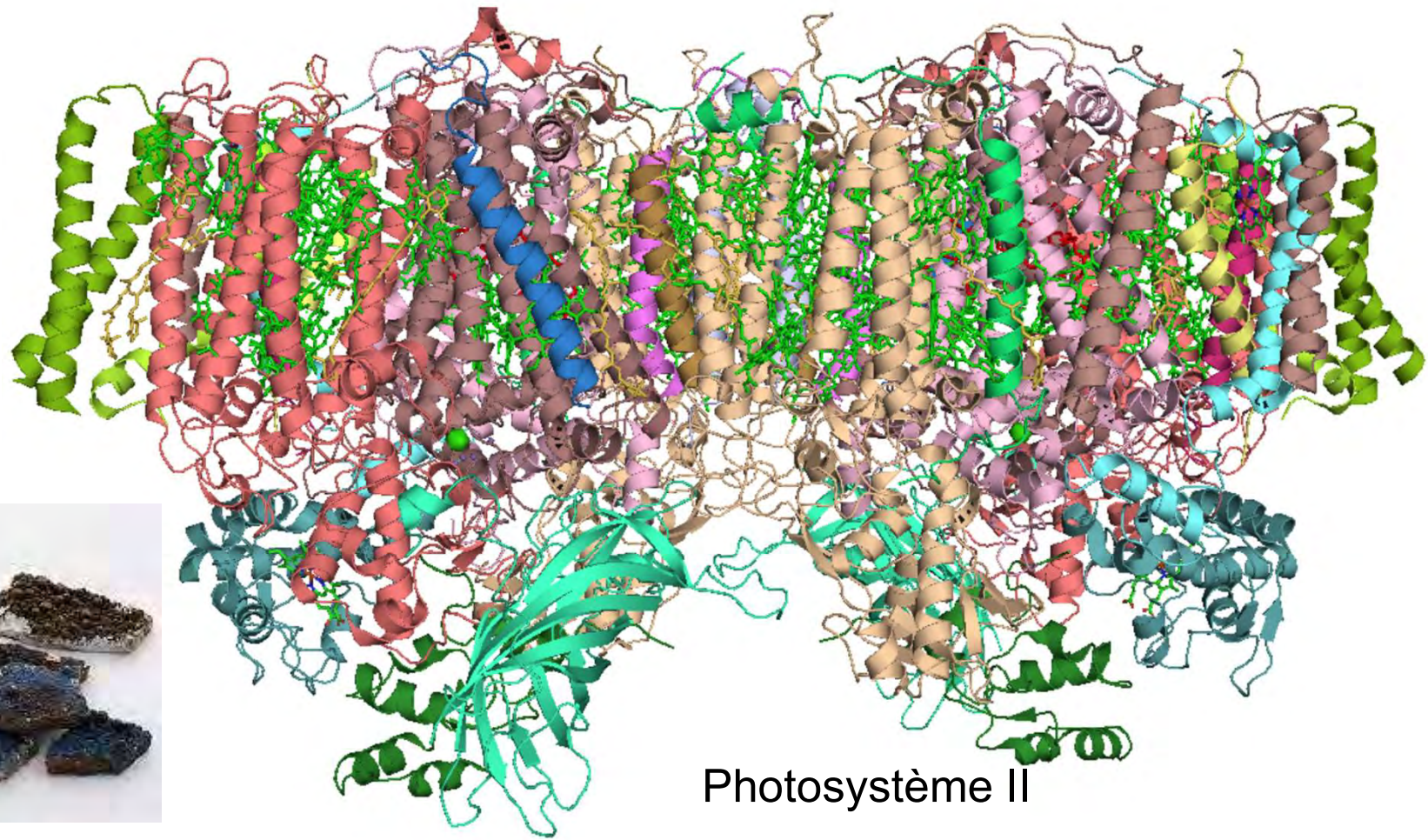
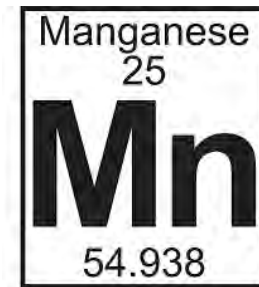
désintégration d'autres éléments

synthétique

Les éléments



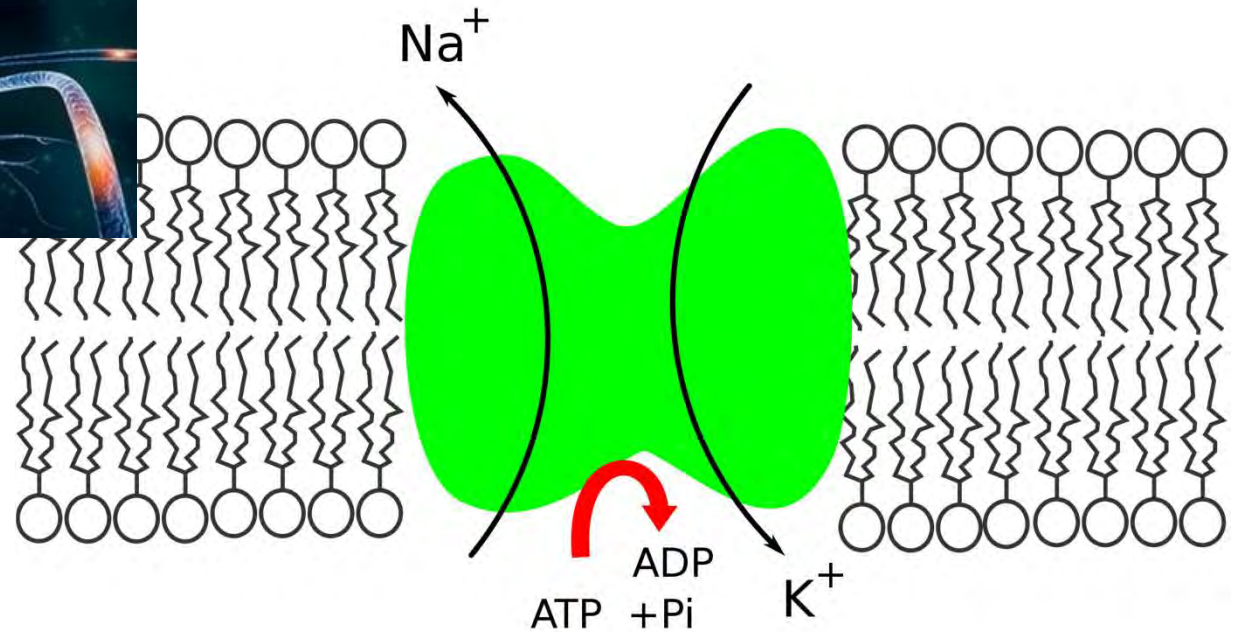
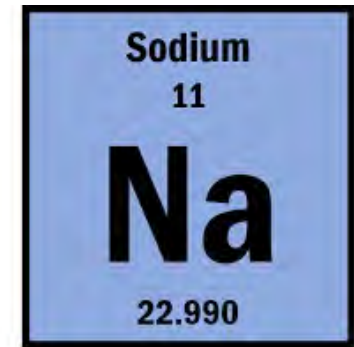
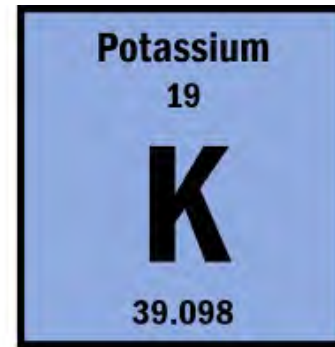
Les éléments

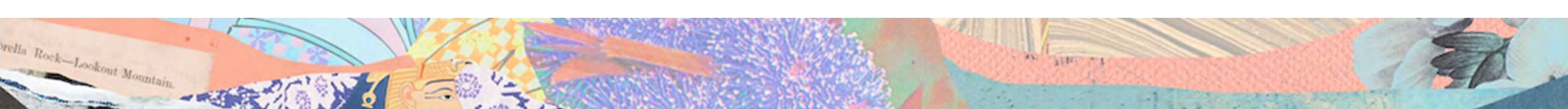


Photosystème II



Les éléments





Les molécules

Inorganiques

Anhydride sulfureux libre / Free sulfur dioxide	<5.0	mg/L
Anhydride sulfureux total / Total sulfur dioxide	<5.0	mg/L

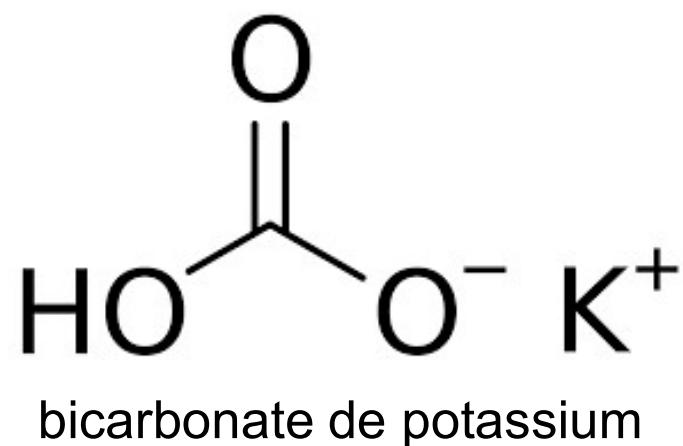
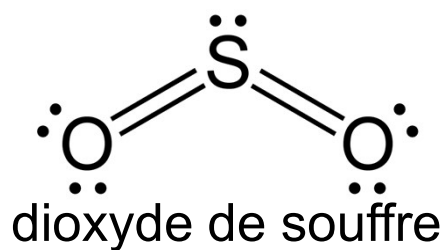
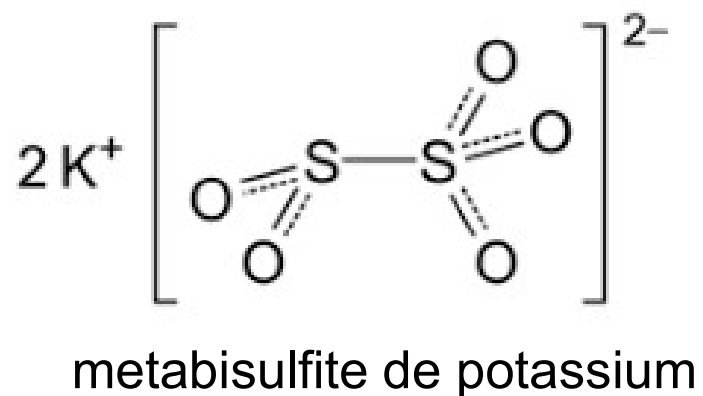
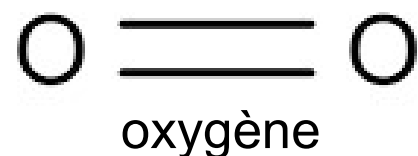
Organiques

Acétaldéhyde / Acetaldehyde	17	mg/L
Acétate d'éthyle / Ethyl acetate	26	mg/L
Acétoine / Acetoin	<10	mg/L
Butanol-1 / 1-Butanol	12	mg/L
Isobutanol / Iso-butanol	24	mg/L
Lactate d'éthyle / Ethyl lactate	130	mg/L
Méthanol / Methanol	72	mg/L
Méthyl-(2+3) butanol-1 / (2+3)-methyl-1-butanol	110	mg/L
Propanol-1 / 1-Propanol	16	mg/L



Les molécules

Inorganiques



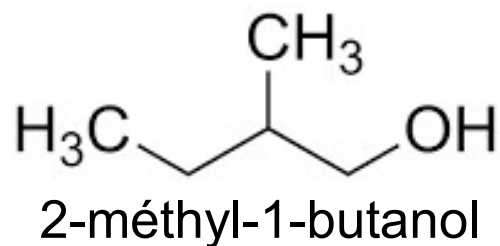
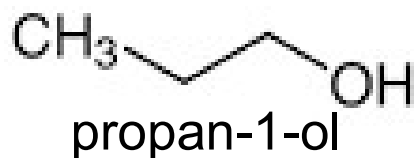
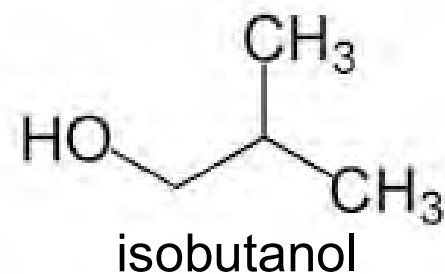
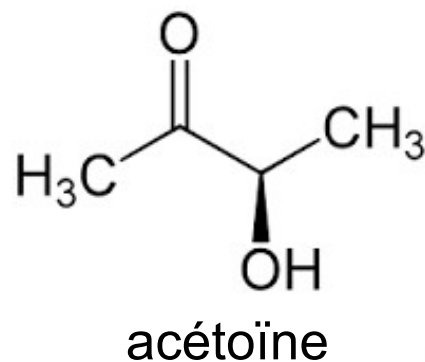
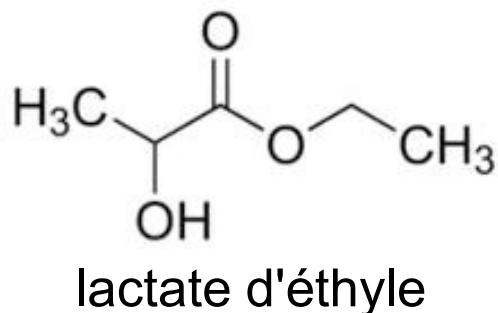
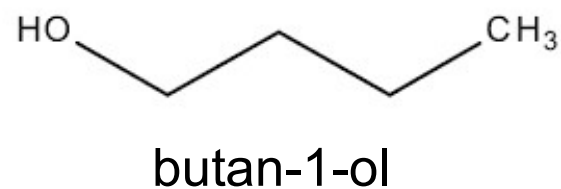
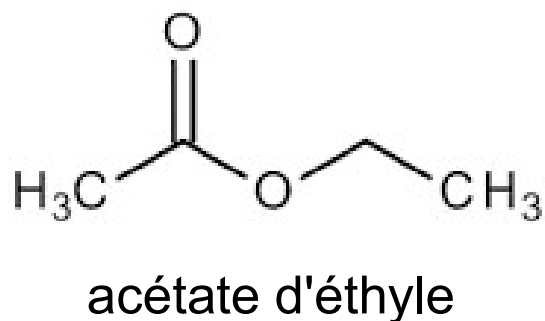
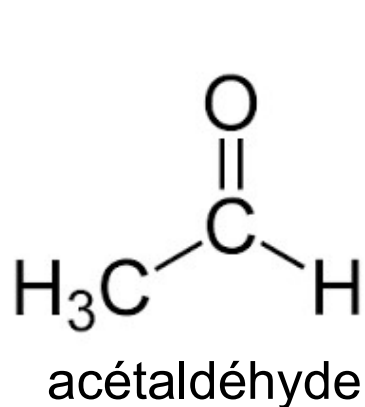
Les molécules

Inorganiques



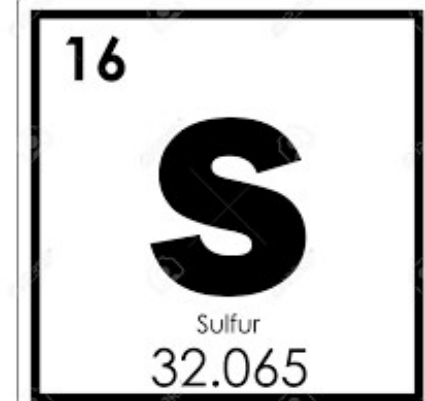
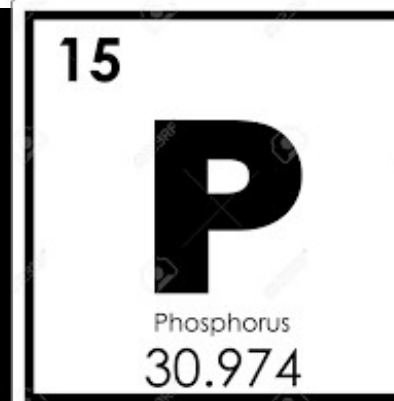
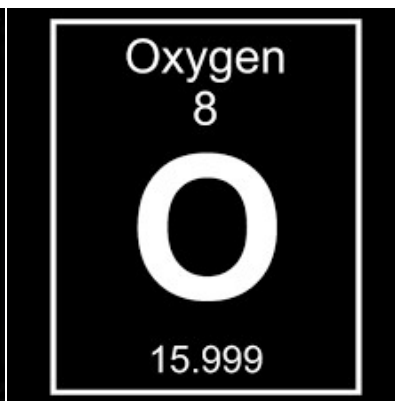
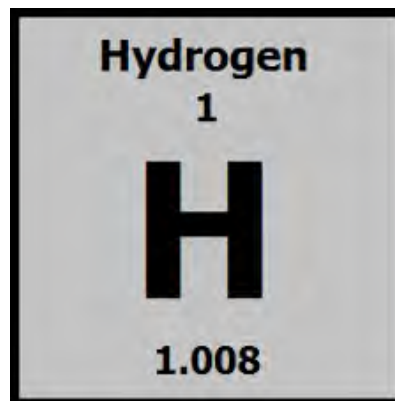
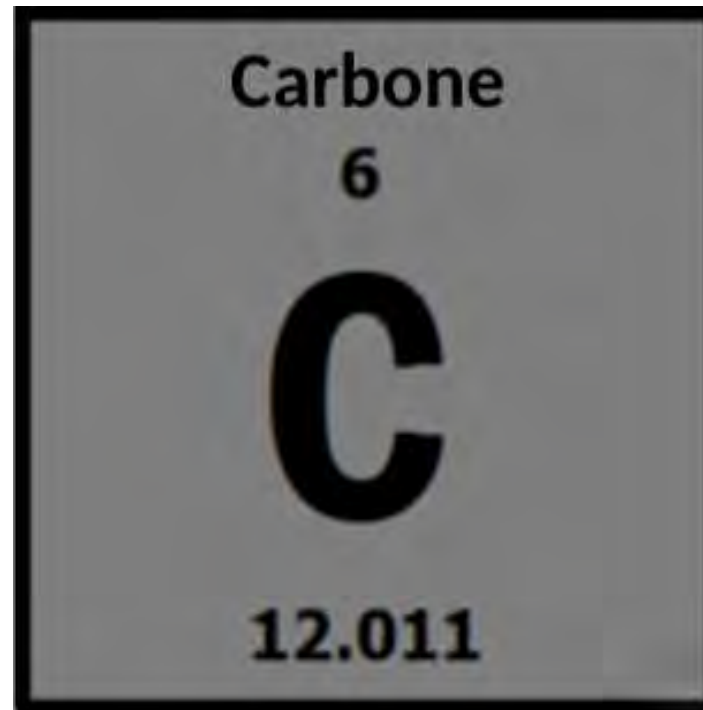
Les molécules

Organiques



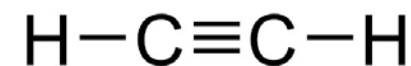
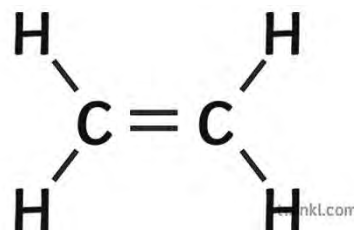
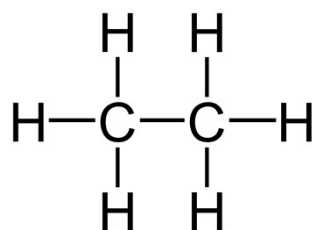
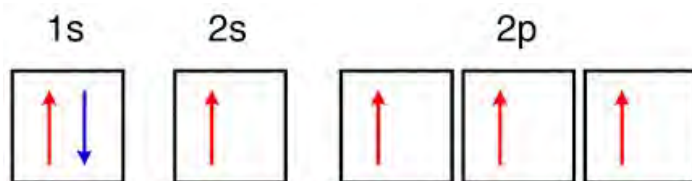
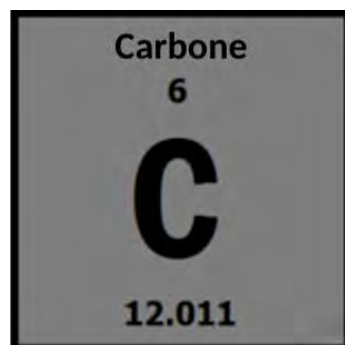
Les molécules

Organiques



Les molécules

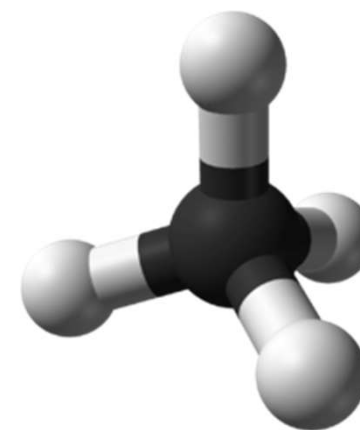
Organiques



dioxyde de carbone



formaldéhyde



méthane

Les molécules

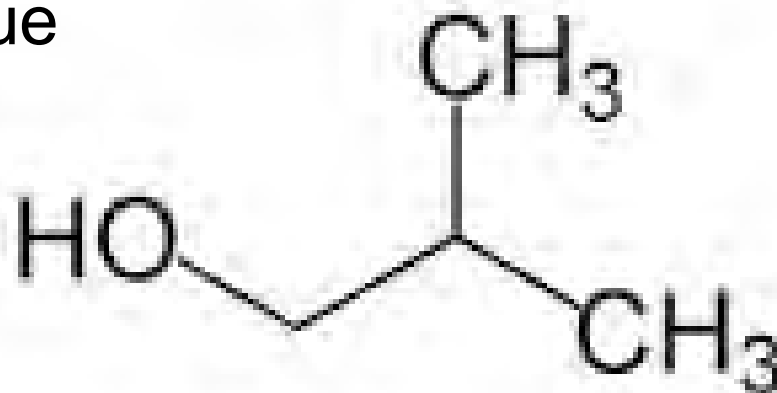
La nomenclature...

Alcool isobutylique

2-Methyl-1-propanol

Alcool 2-methylpropylique

Isopropylcarbinol



~~Isobutanol~~

2-Methylpropan-1-ol

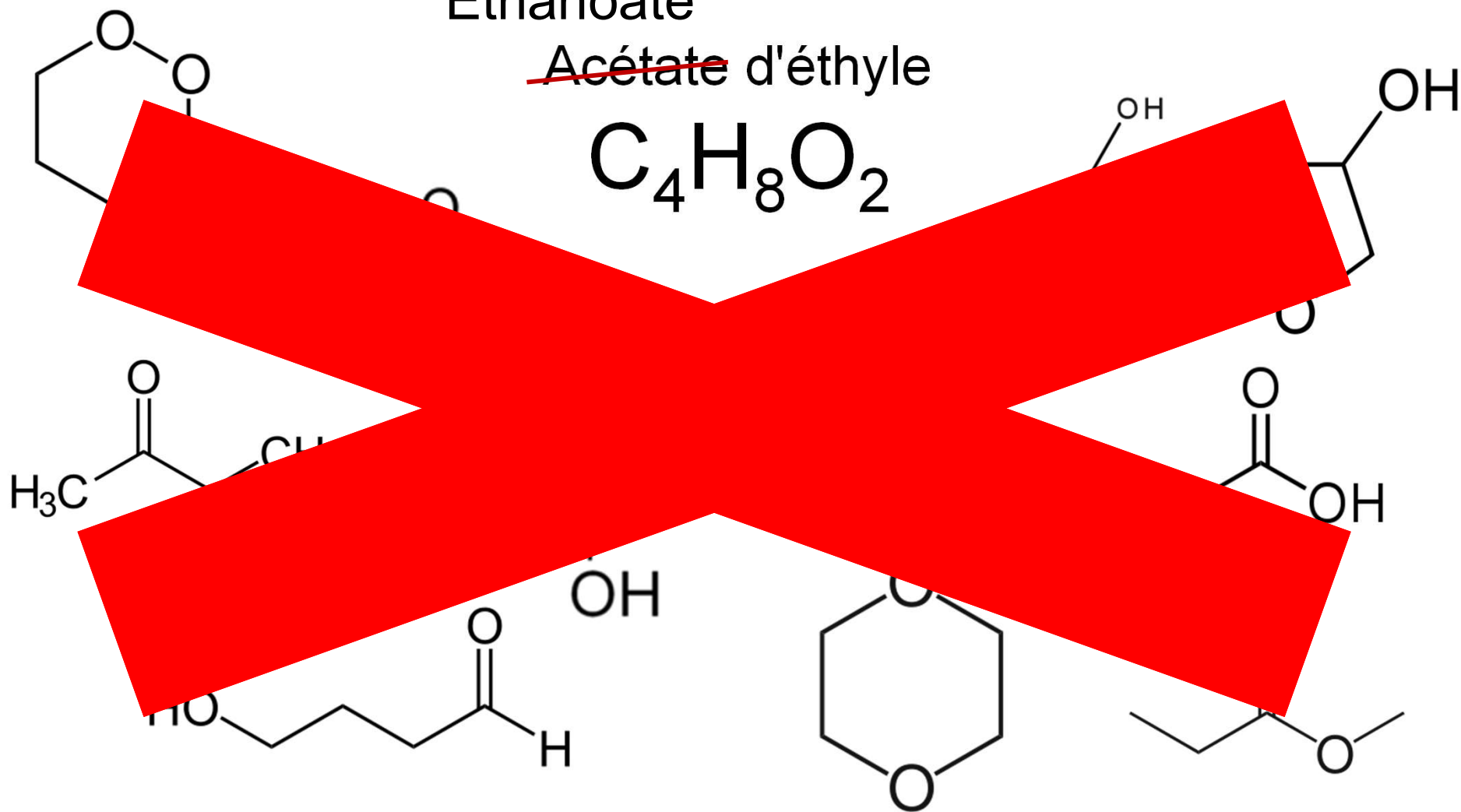
Numéro CAS 78-83-1

Les molécules

La représentation...

Éthanoate

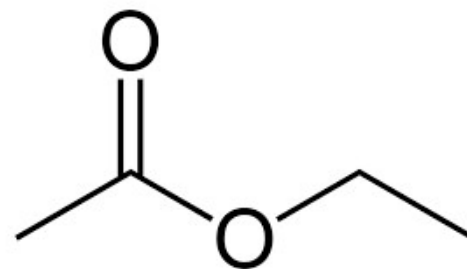
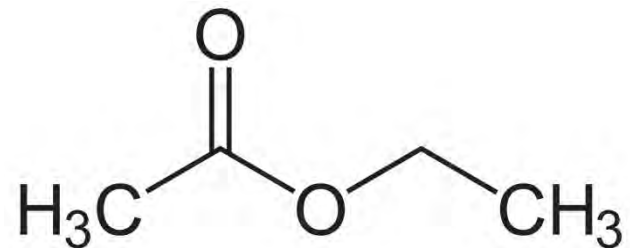
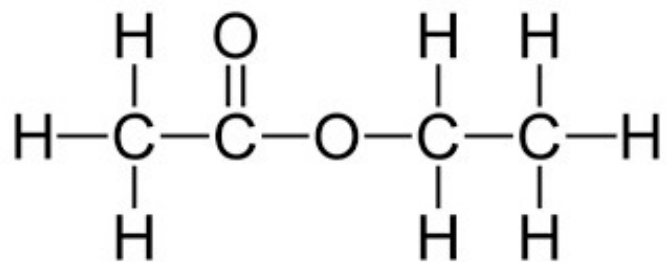
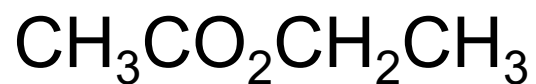
~~Acétate~~ d'éthyle



Les molécules

La représentation...

Acétate d'éthyle



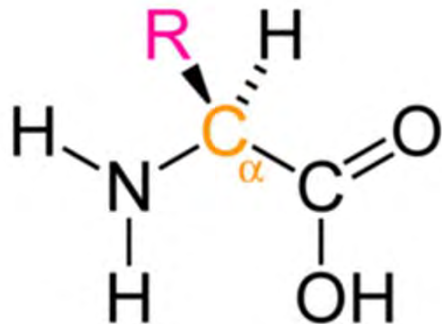
Les molécules

Les familles...

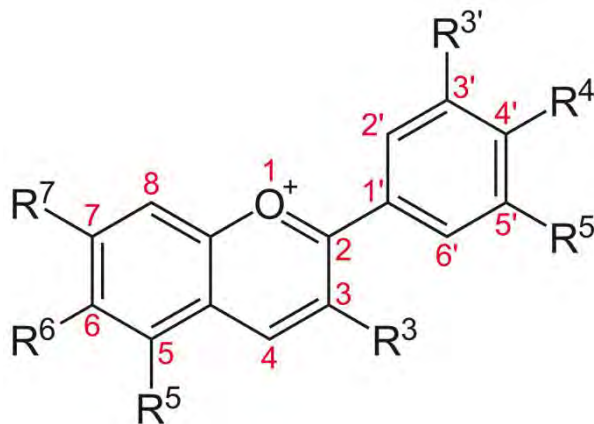
Fonctions

Fonction	Alcool	Aldéhyde	Cétone	Acide carboxylique	Alcène	Ester	Amine	Amide
Groupe caractéristique	$-O-H$	$\begin{array}{c} O \\ \parallel \\ -C \\ \\ H \end{array}$	$\begin{array}{c} O \\ \parallel \\ C-C \\ \quad \\ \quad C \end{array}$	$\begin{array}{c} O \\ \parallel \\ -C \\ \\ OH \end{array}$	$\begin{array}{c} \diagup \quad \diagdown \\ C=C \\ \diagdown \quad \diagup \end{array}$	$\begin{array}{c} O \\ \parallel \\ -C \\ \\ O-C \end{array}$	$\begin{array}{c} \diagup \quad \diagdown \\ -N \\ \diagdown \quad \diagup \end{array}$	$\begin{array}{c} O \\ \parallel \\ -C \\ \\ N- \\ \end{array}$
	Hydroxyle	Carbonyle	Carbonyle	Carboxyle	Alcène	Ester	Amine	Amide

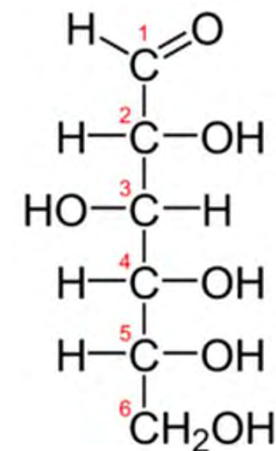
Structures



Acides aminés



Anthocyanes



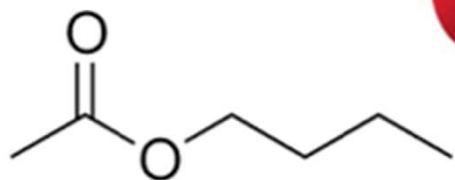
Glucides

Les molécules

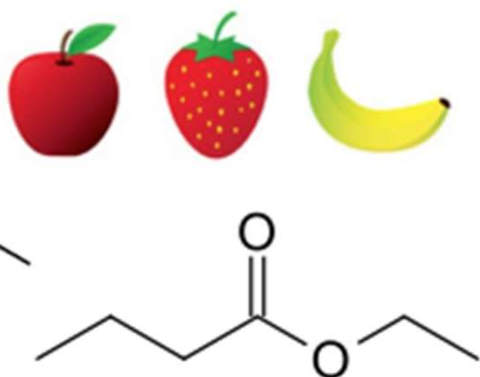
Propriétés, ex: volatiles

Les familles...

Esters

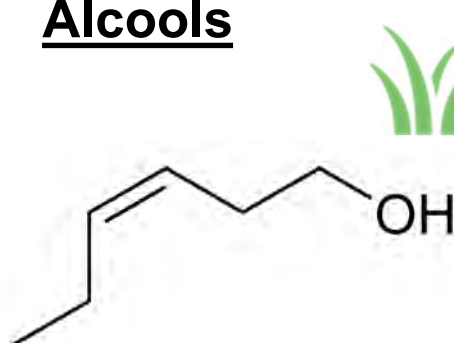


Acétate de butyle

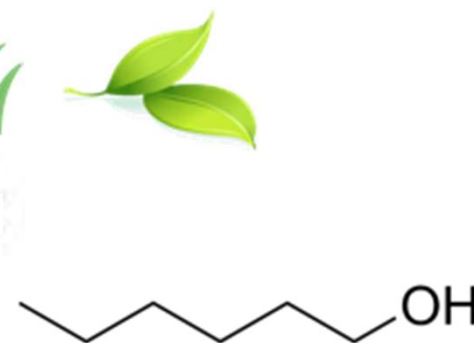


Butanoate d'éthyle

Alcools

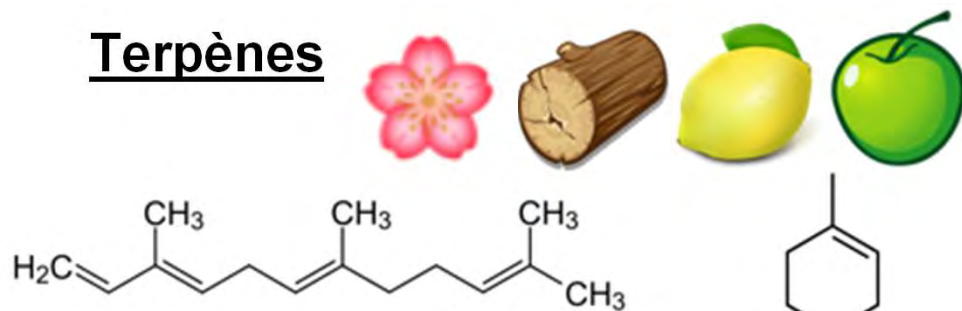


cis-3-hexenol

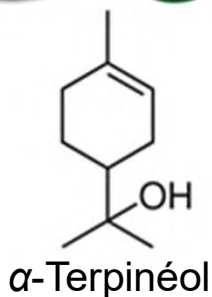


Hexanol

Terpènes

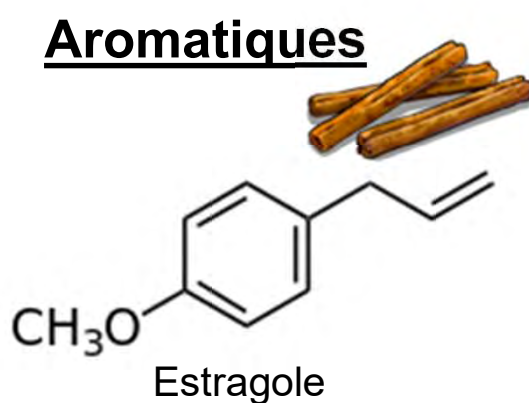


α -Farnésène



α -Terpinéol

Aromatiques



Estragole

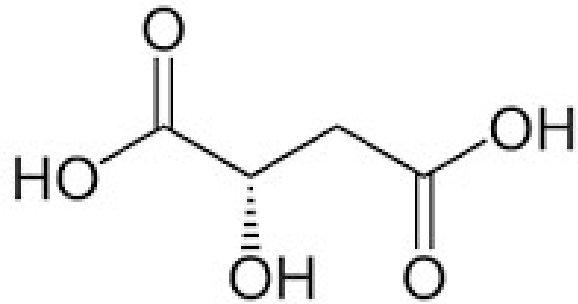


Benzaldéhyde

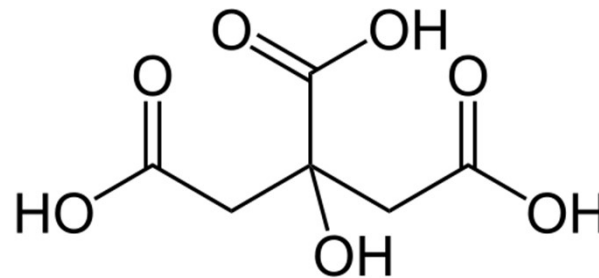
Les molécules

Les familles

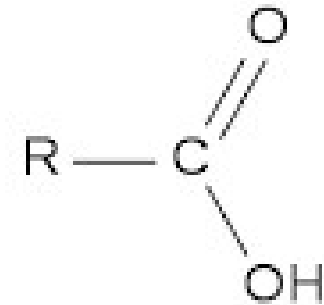
Les acides



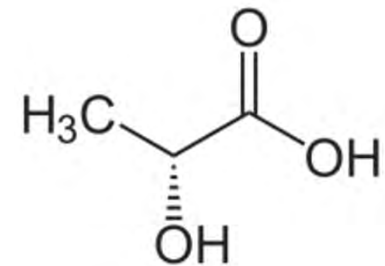
acide malique



acide citrique



Carboxyle (-COOH)

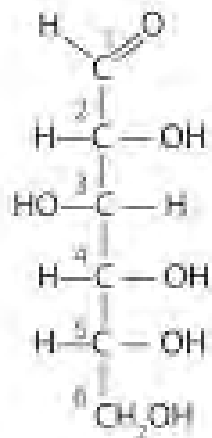


acide lactique

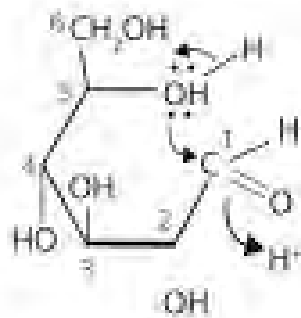
Les molécules

Les familles

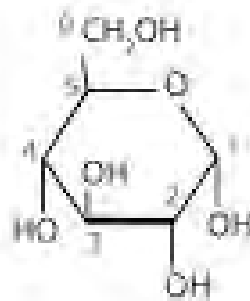
Les sucres



(a) Fischer projection

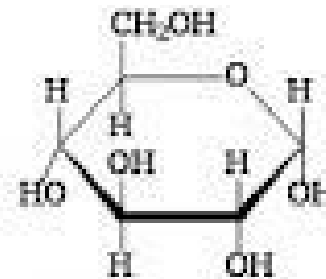


(b) Three-dimensional representation

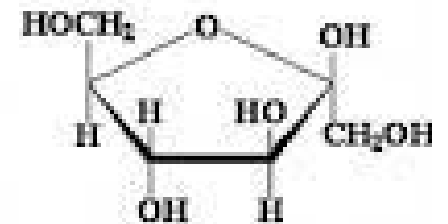


(c) Cyclic monosaccharide

A

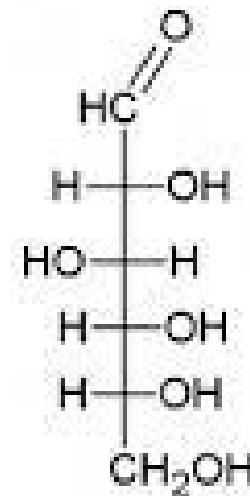


Glucose

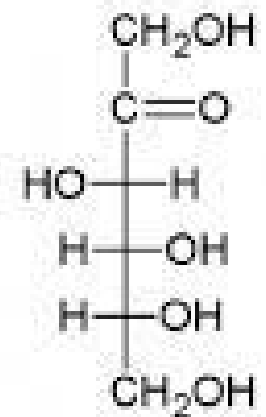


Fructose

B



Glucose

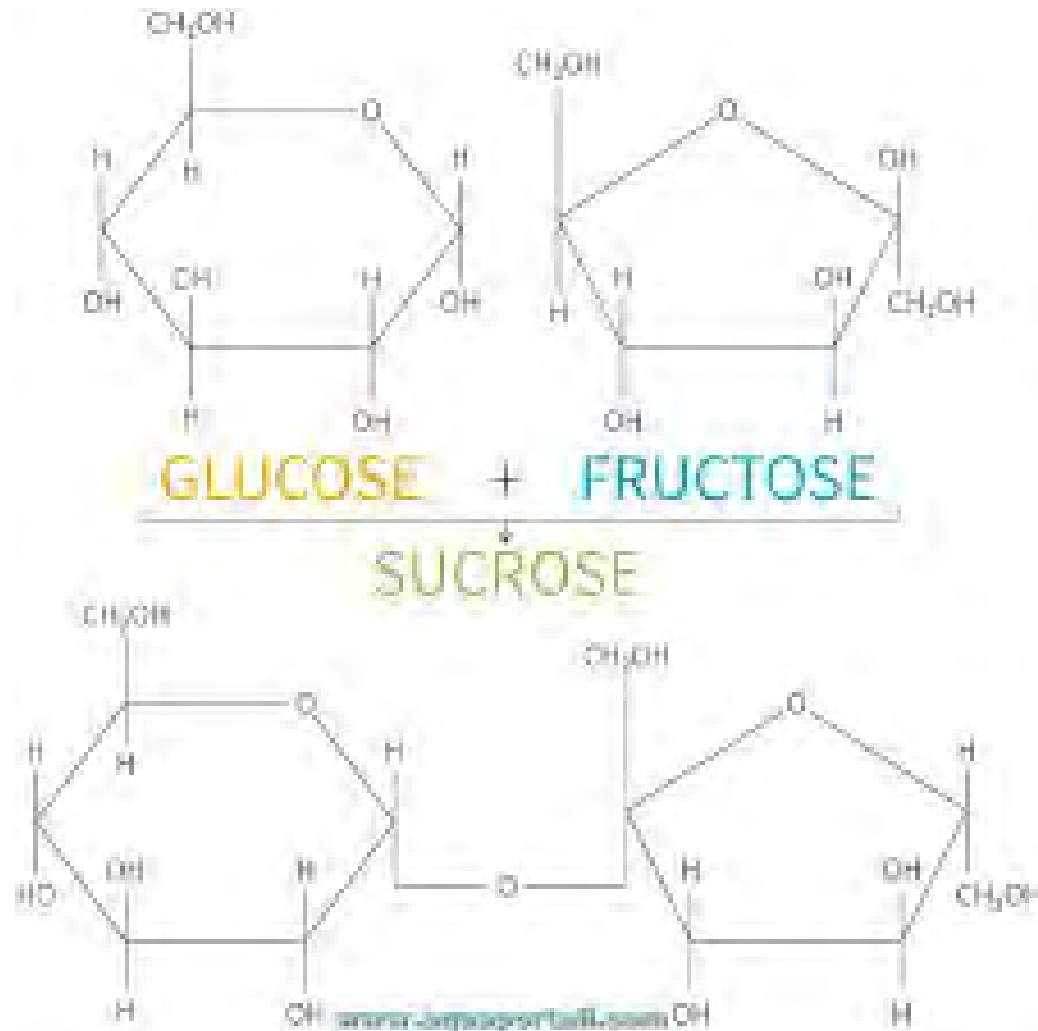


Fructose

Les molécules

Les familles

Les sucres

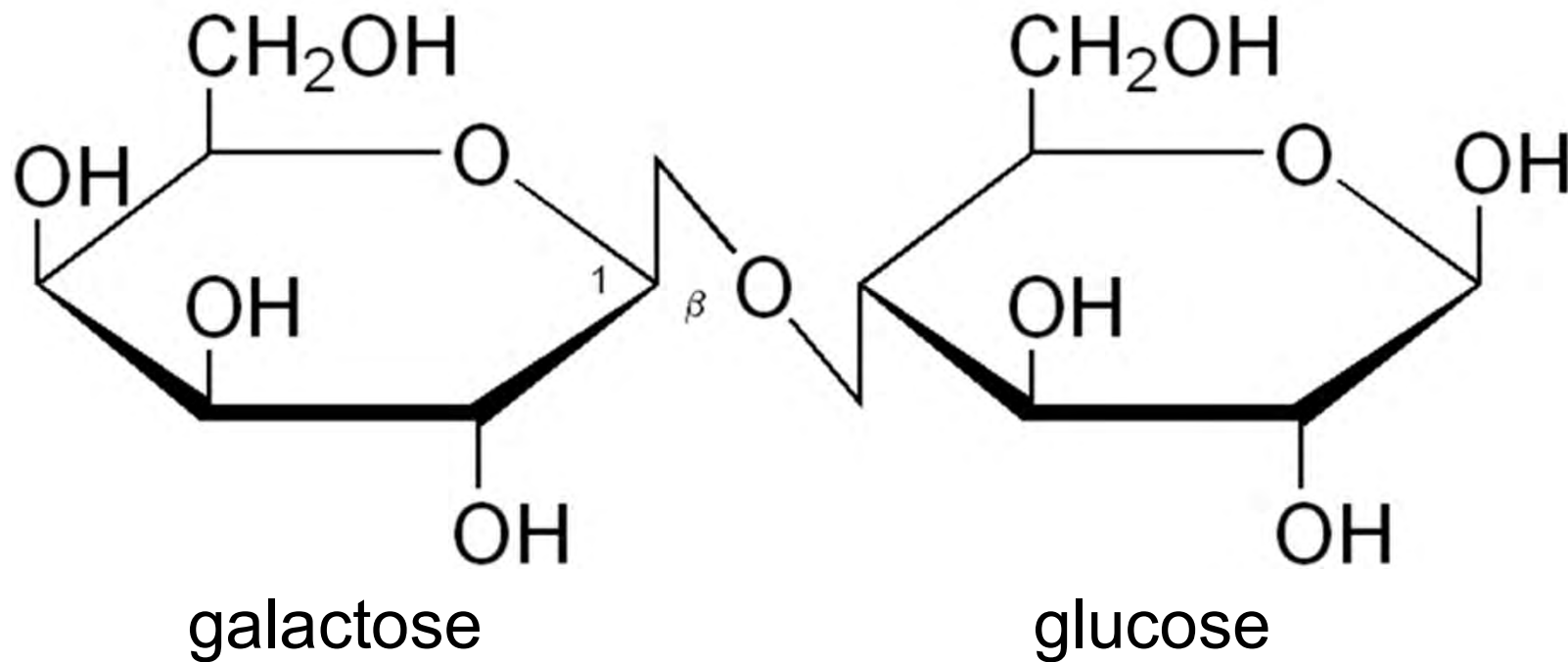


Les molécules

Les familles

Les sucres

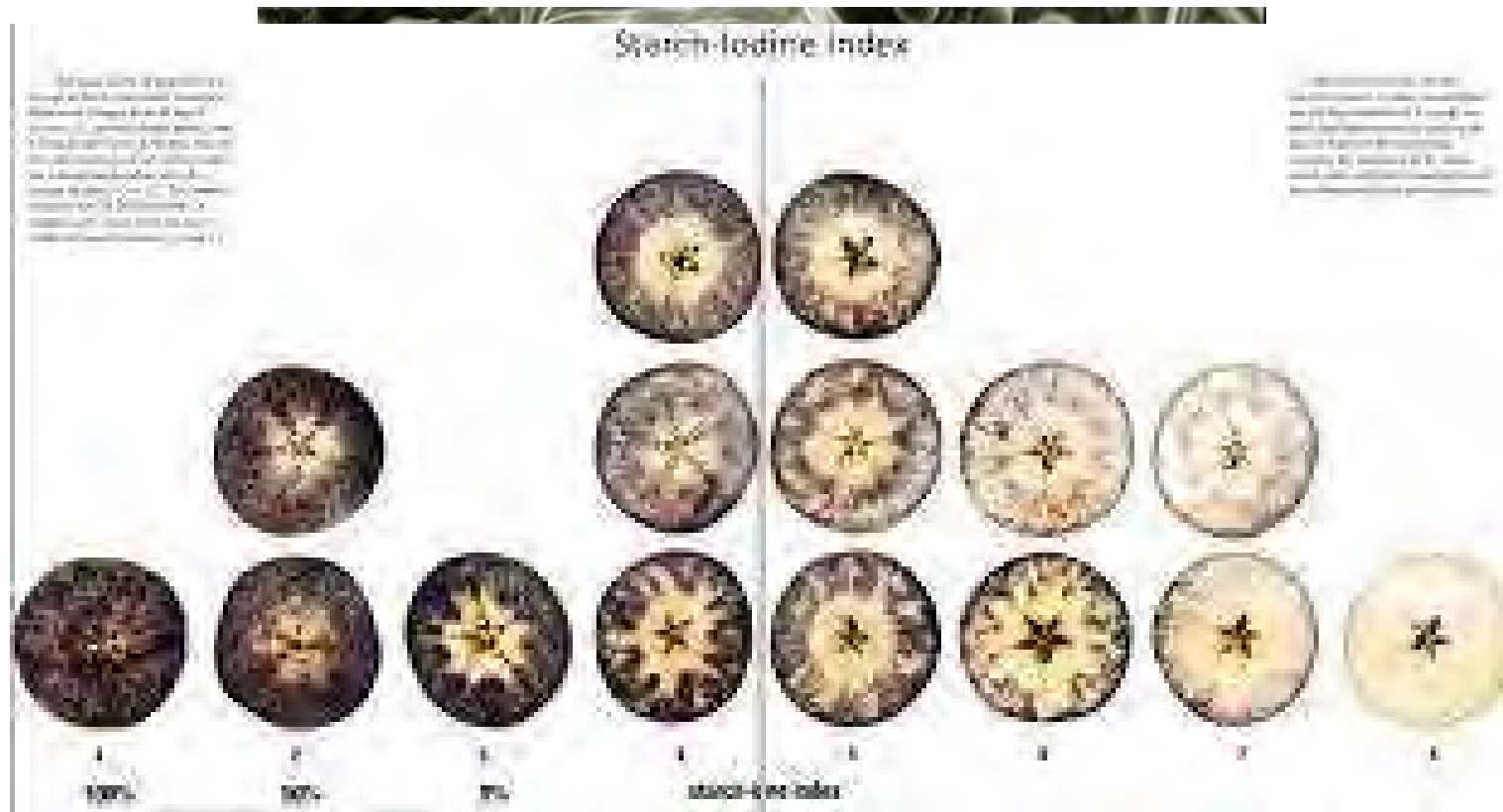
Lactose



Les molécules

Les familles

Les sucres

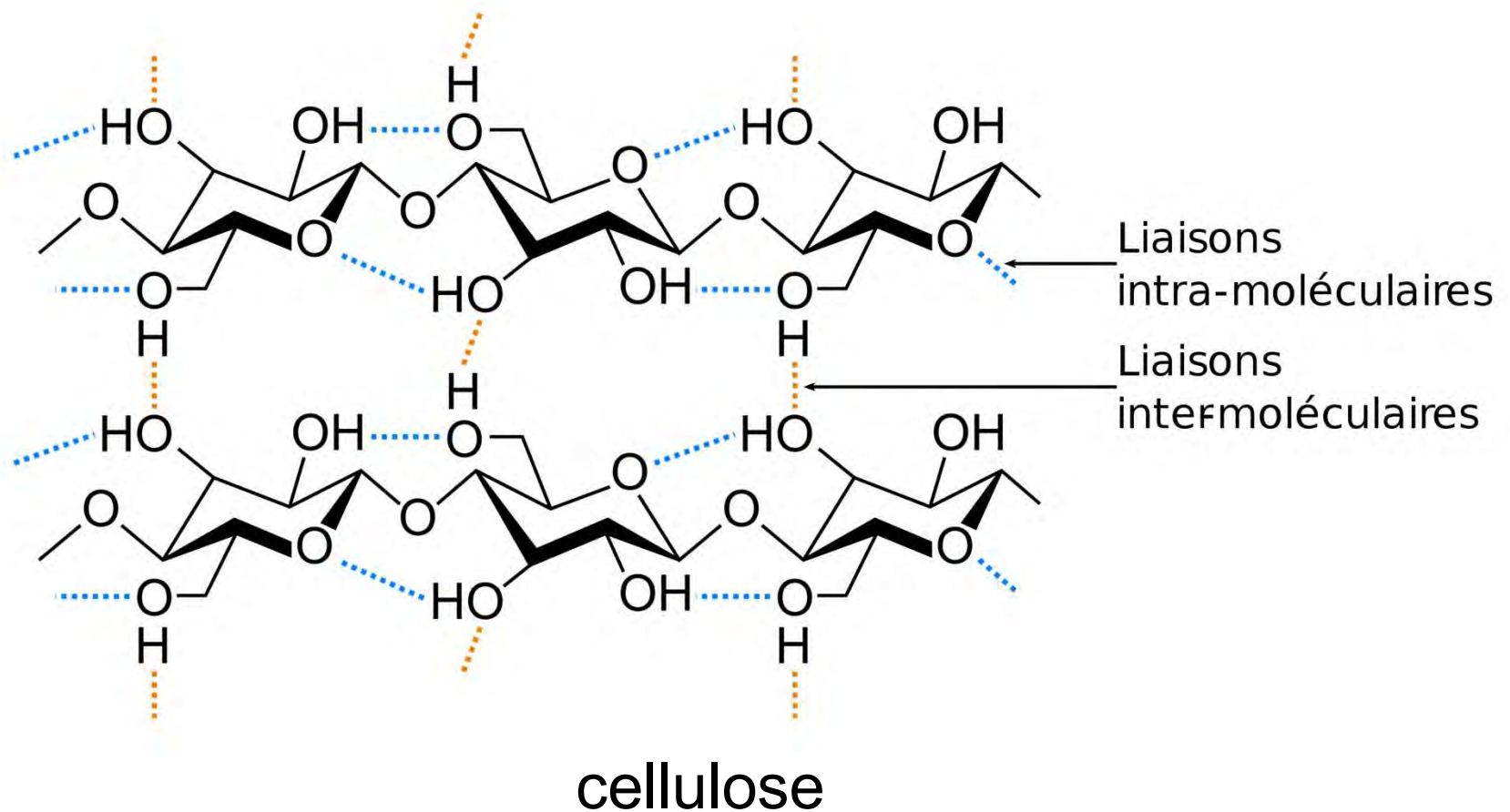


amidon

Les molécules

Les familles

Les sucres



Les molécules

Les familles

Les sucres



pectine

Les molécules

Les tanins

Les familles



Les molécules

Les familles

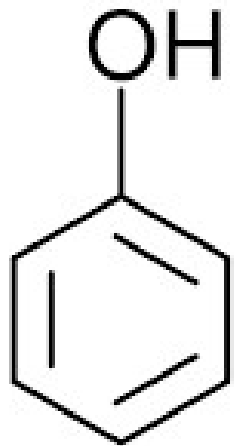
Les tanins



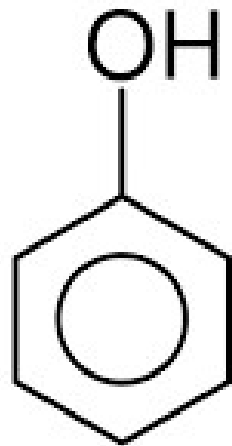
Les molécules

Les familles

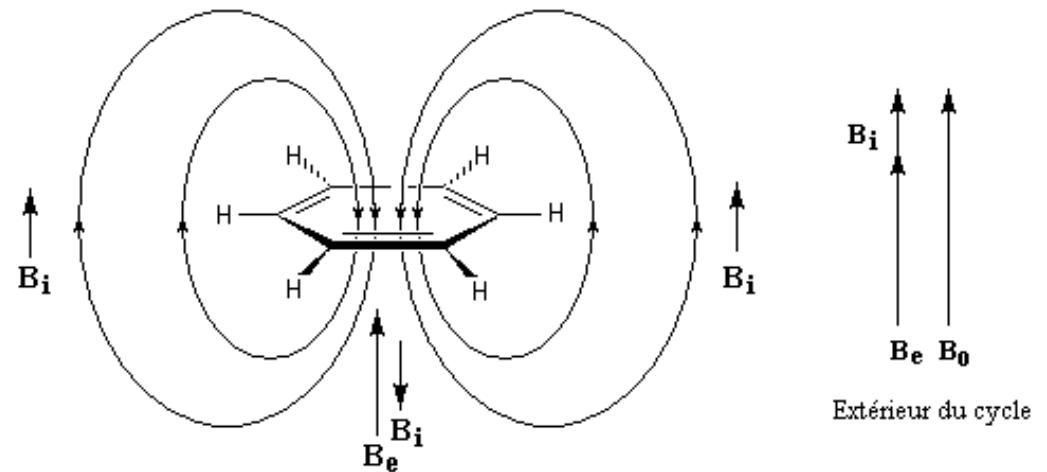
Les tanins



or



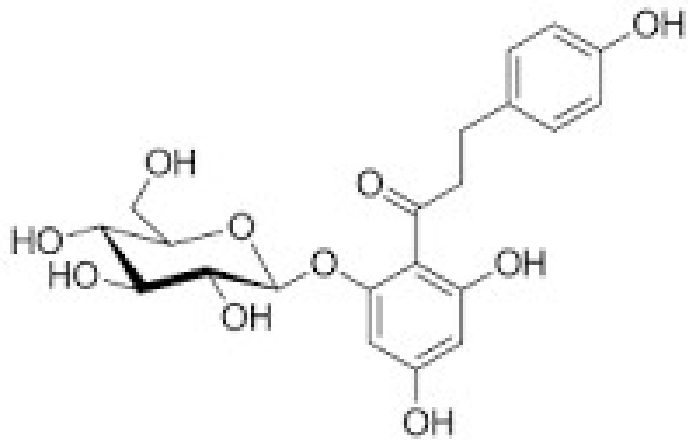
phénol



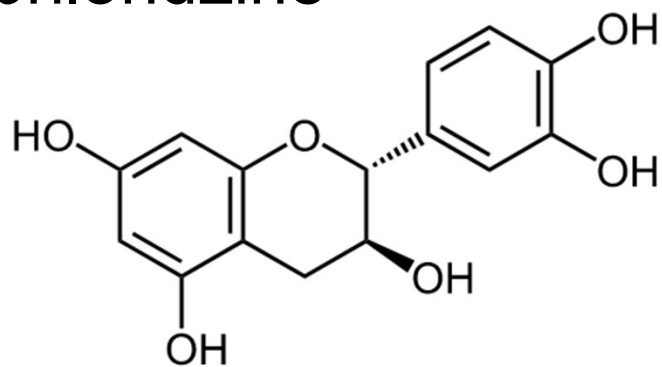
Les molécules

Les familles

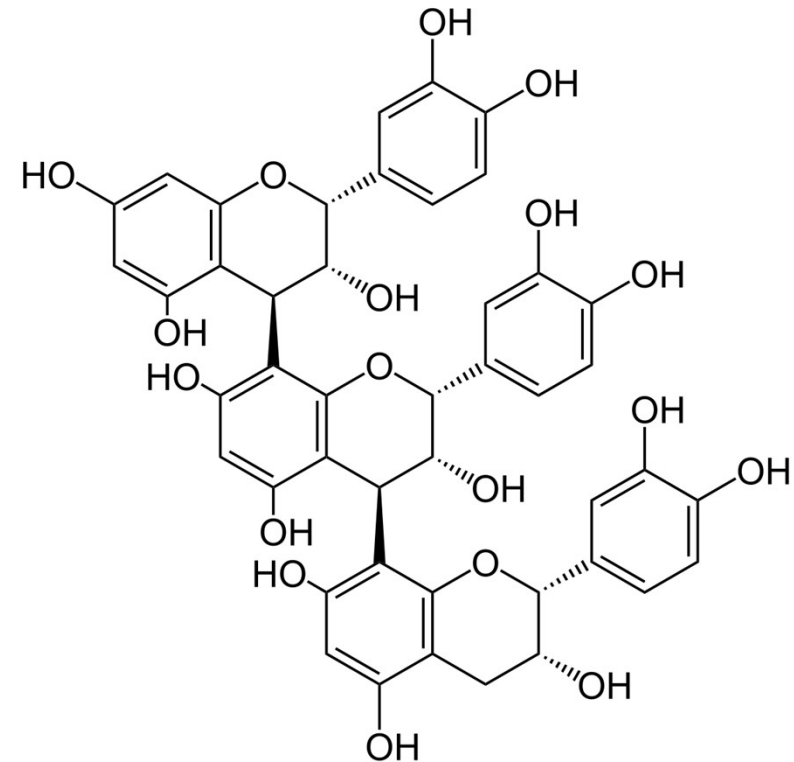
Les tanins



phloridzine



catéchine

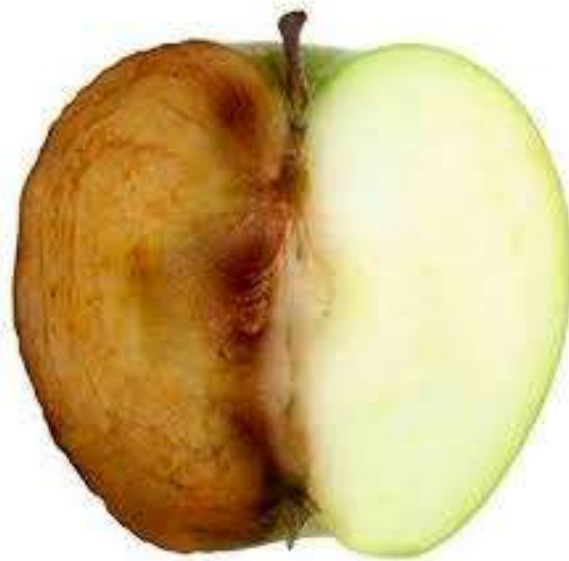
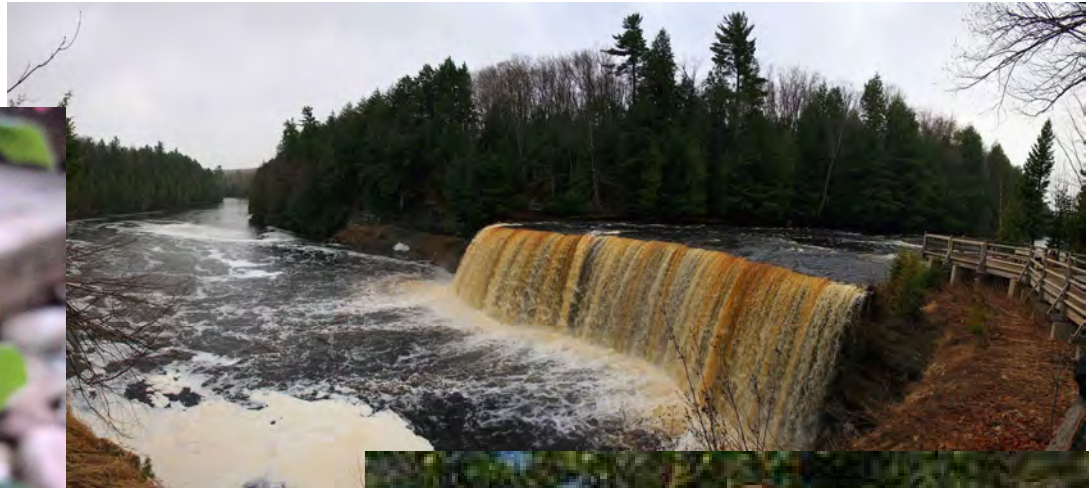


procyanidine C1

Les molécules

Les familles

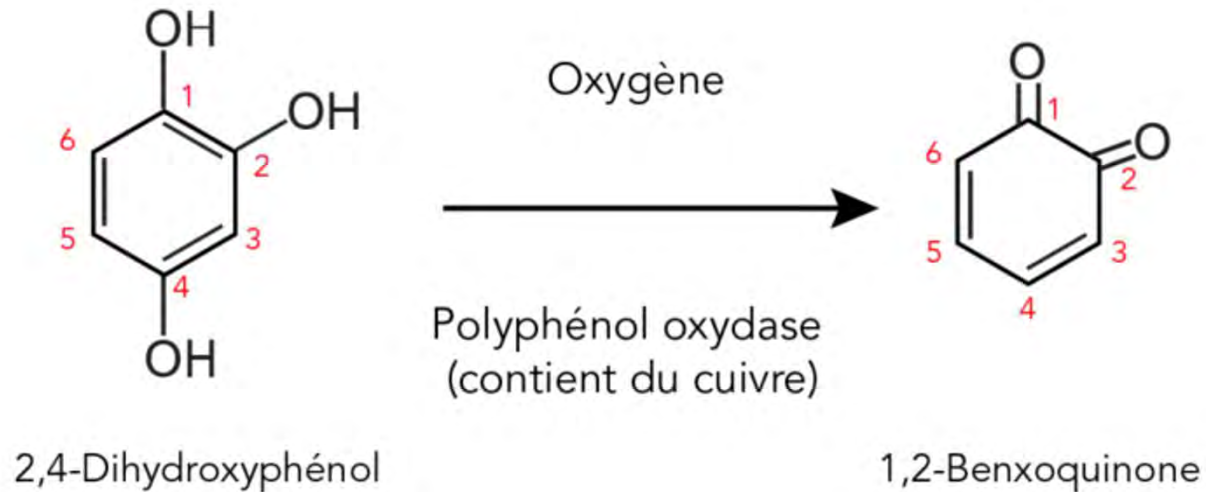
Les tanins



Les molécules

Les familles

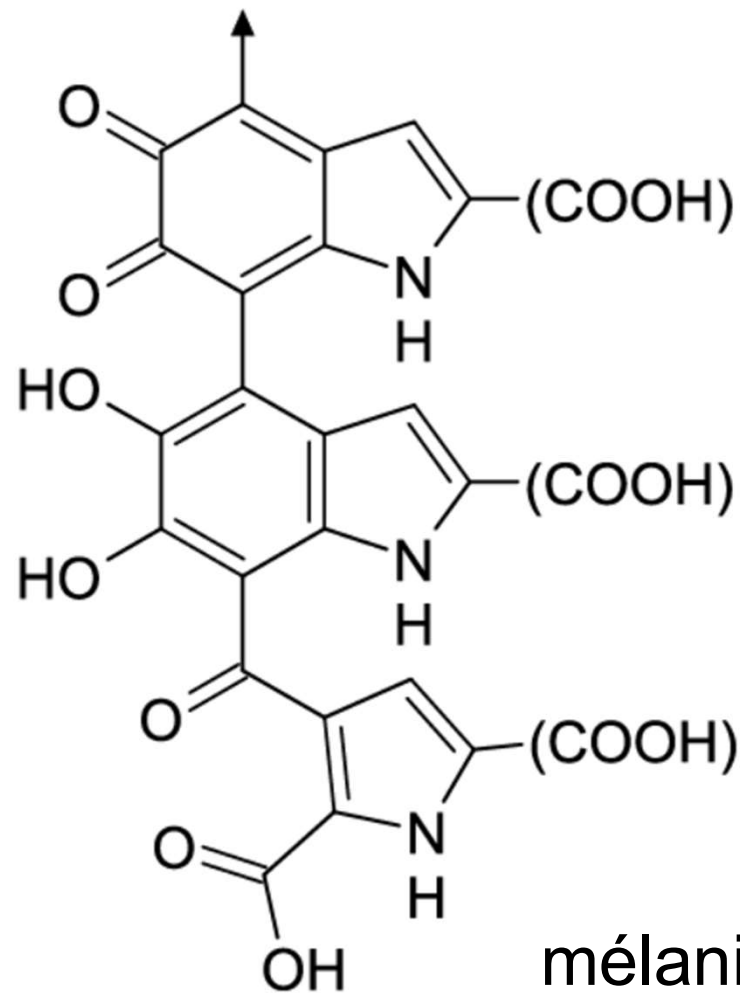
Les tanins



Les molécules

Les familles

Les tanins

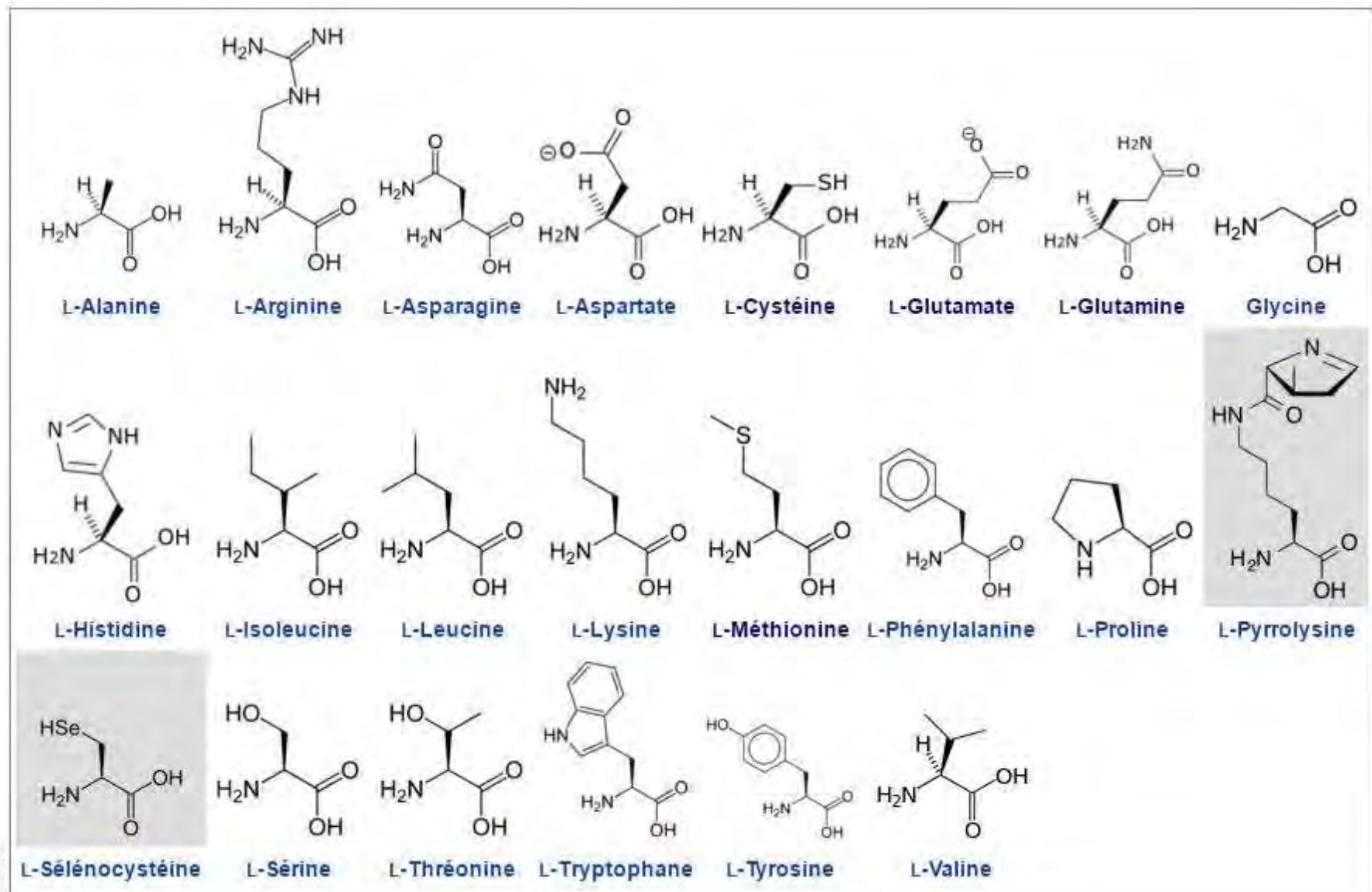


mélanine

Les molécules

Les familles

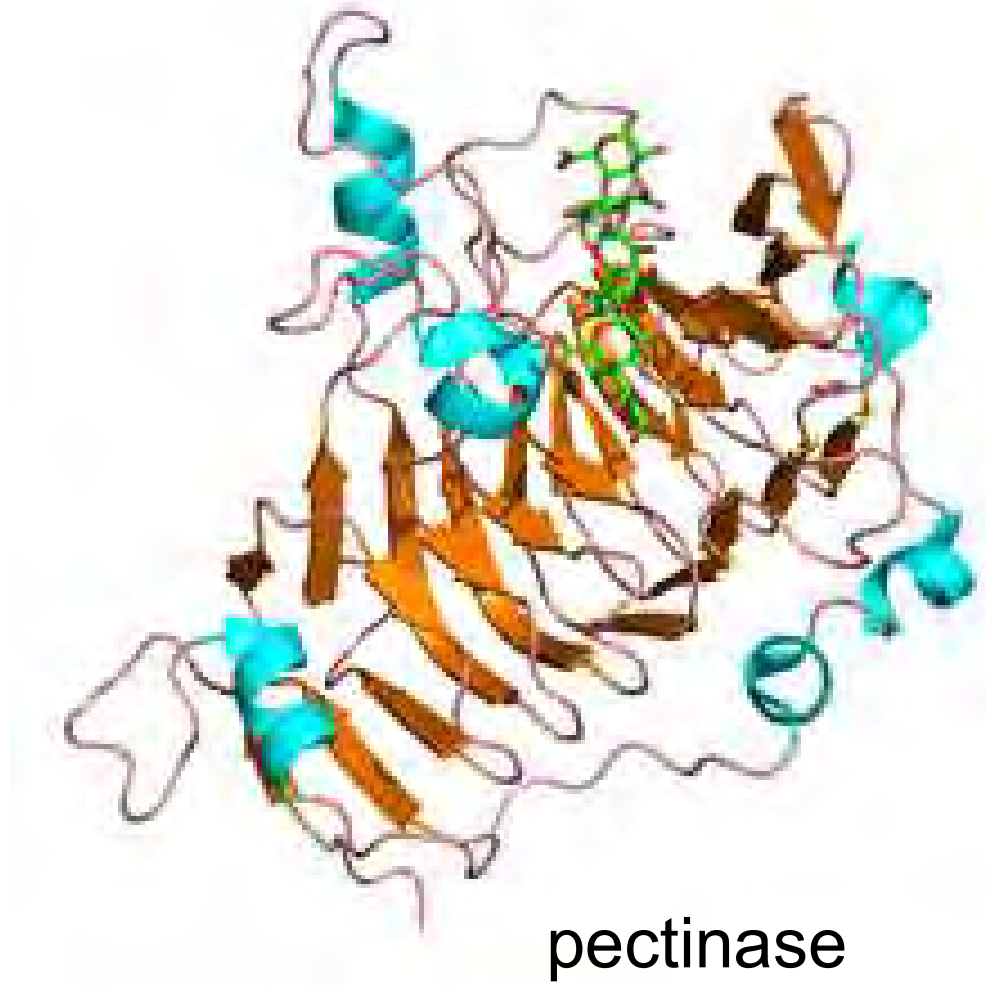
Les acides aminés et les protéines



Les molécules

Les familles

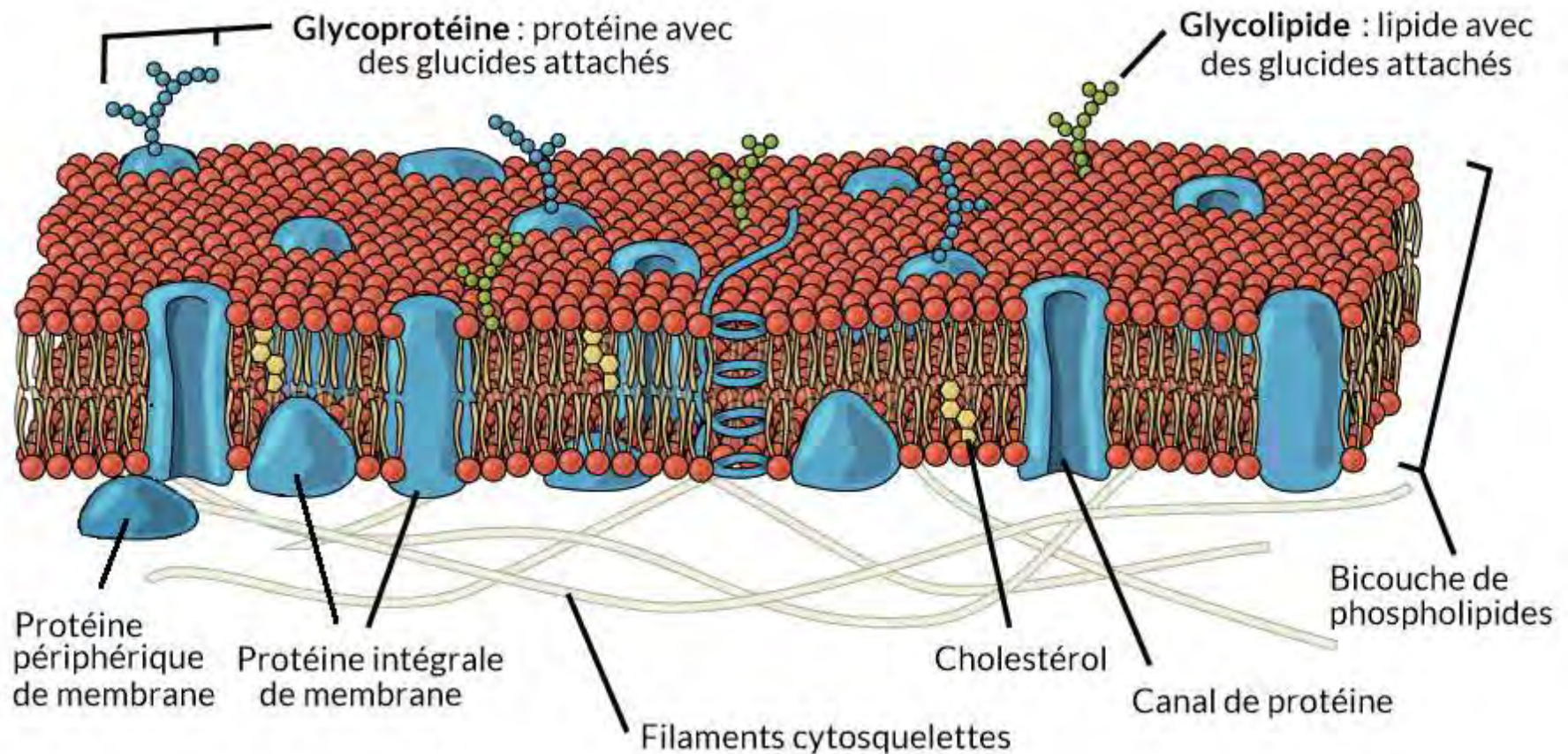
Les acides aminés et les protéines



Les molécules

Les familles

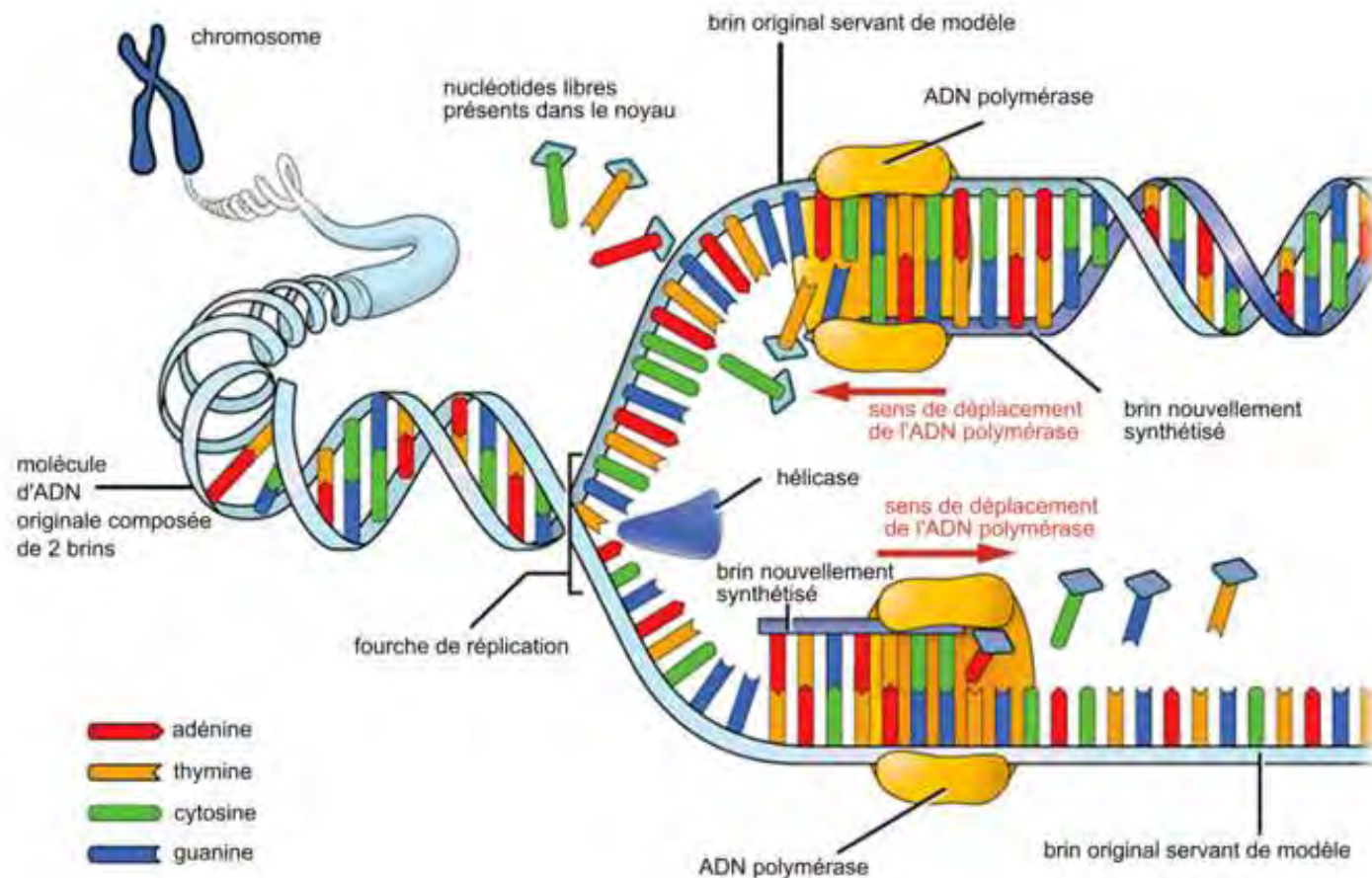
Les acides aminés et les protéines

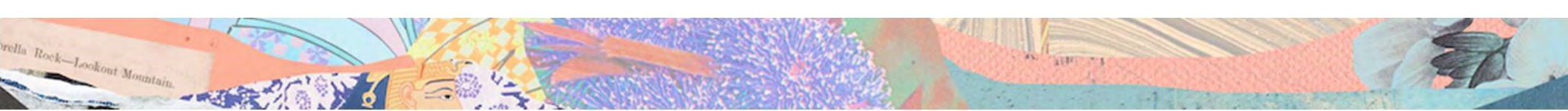


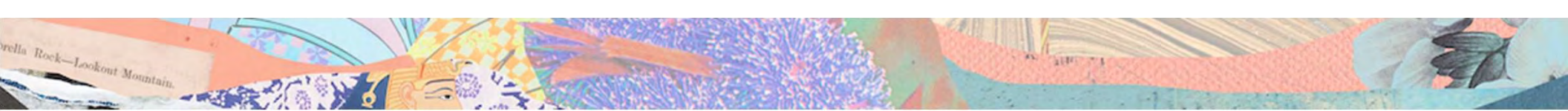
Les molécules

Les familles

Les acides aminés et les protéines







Merci!
Questions?

