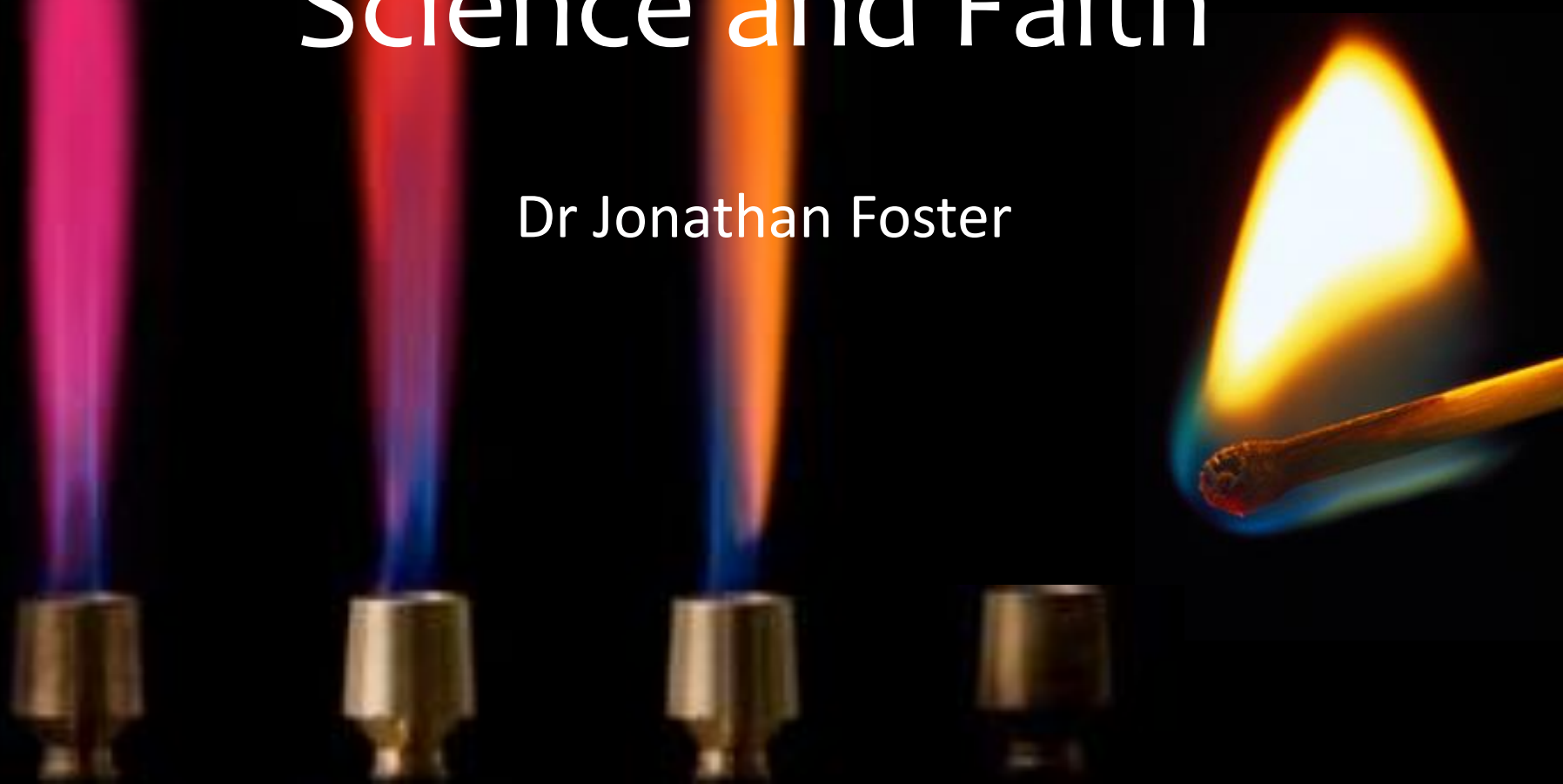


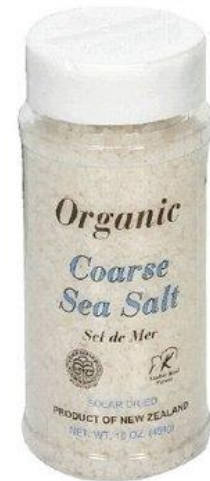
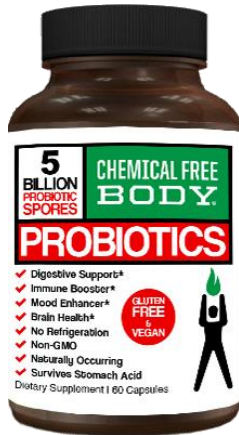
Reigniting the Chemistry between Science and Faith

Dr Jonathan Foster



The Science of Stuff

(and how to turn stuff into other stuff)



FIELDS ARRANGED BY PURITY

→
MORE PURE

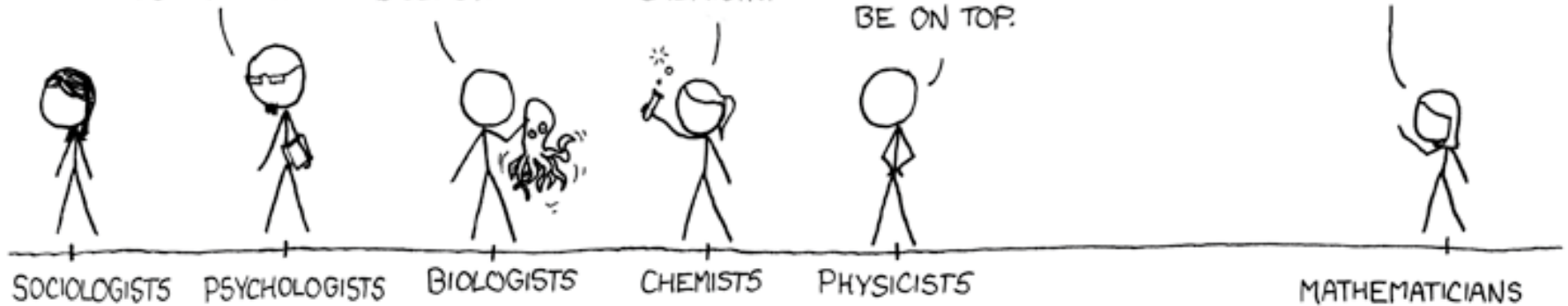
SOCIOLOGY IS
JUST APPLIED
PSYCHOLOGY

PSYCHOLOGY IS
JUST APPLIED
BIOLOGY.

BIOLOGY IS
JUST APPLIED
CHEMISTRY

WHICH IS JUST
APPLIED PHYSICS.
IT'S NICE TO
BE ON TOP.

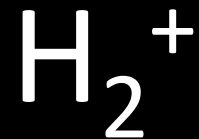
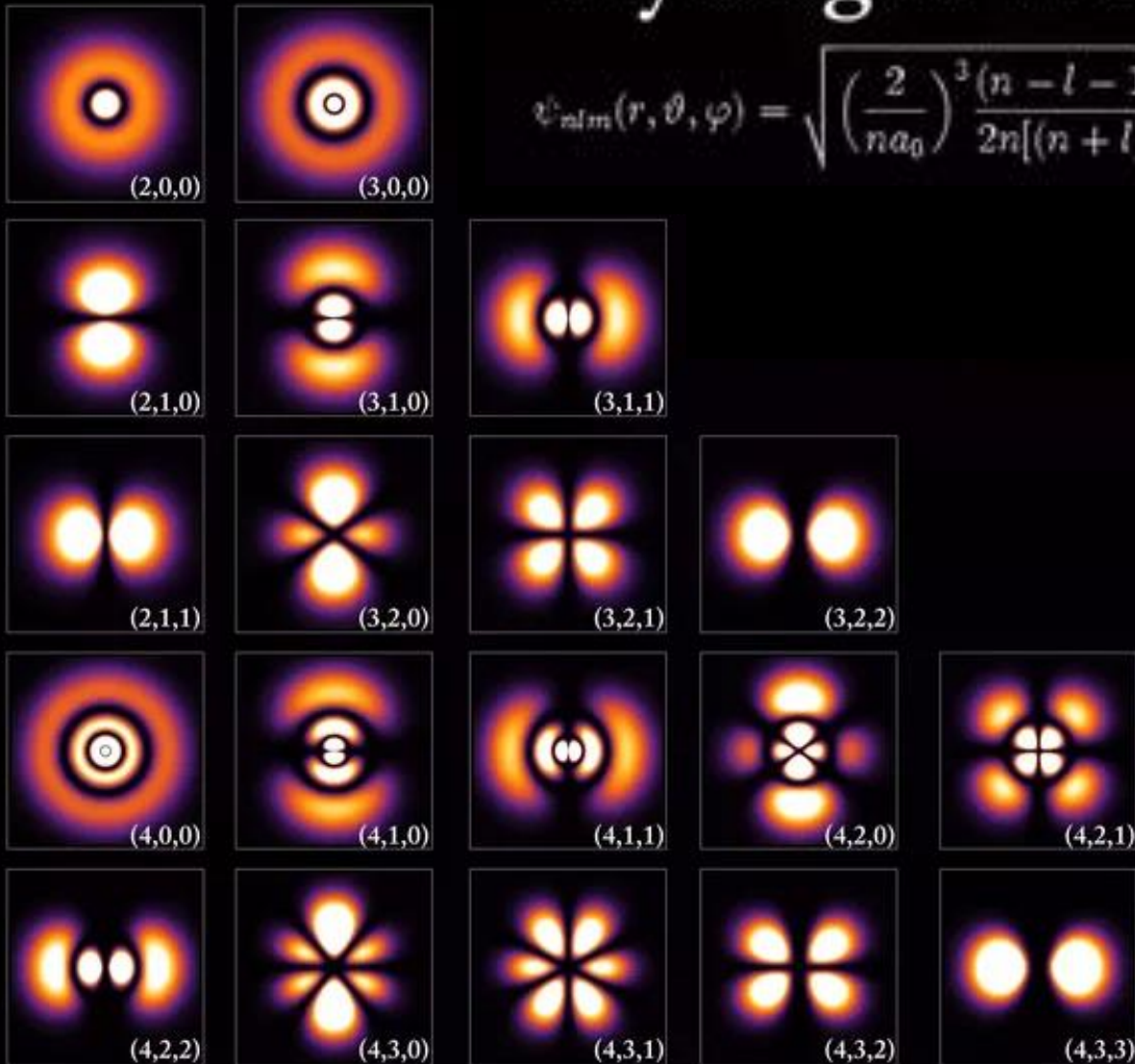
OH, HEY, I DIDN'T
SEE YOU GUYS ALL
THE WAY OVER THERE.



Hydrogen Wave Function

Probability density plots.

$$\psi_{nlm}(r, \vartheta, \varphi) = \sqrt{\left(\frac{2}{na_0}\right)^3 \frac{(n-l-1)!}{2n[(n+l)!]}} e^{-\rho/2} \rho^l L_{n-l-1}^{2l+1}(\rho) \cdot Y_{lm}(\vartheta, \varphi)$$



The Periodic Table

1

IA

1A

1

H

Hydrogen

1

1s¹

2

IIA

2A

3

Li

Lithium

3

[He]2s¹

4

Be

Beryllium

4

[He]2s²

11

Na

Sodium

11

[Ne]3s¹

12

Mg

Magnesium

12

[Ne]3s²

19

K

Potassium

19

[Ar]4s¹

20

Ca

Calcium

20

[Ar]4s²

37

Rb

Rubidium

37

[Kr]5s¹

38

Sr

Strontium

38

[Kr]5s²

55

Cs

Cesium

55

[Xe]6s¹

87

Fr

Francium

87

[Rn]7s¹

2

He

Helium

2

1s²

3

Li

Lithium

3

[He]2s¹

4

Be

Beryllium

4

[He]2s²

11

Na

Sodium

11

[Ne]3s¹

12

Mg

Magnesium

12

[Ne]3s²

19

K

Potassium

19

[Ar]4s¹

20

Ca

Calcium

20

[Ar]4s²

37

Rb

Rubidium

37

[Kr]5s¹

38

Sr

Strontium

38

[Kr]5s²

55

Cs

Cesium

55

[Xe]6s¹

87

Fr

Francium

87

[Rn]7s¹

13

B

Boron

13

[He]2s²2p¹

14

C

Carbon

14

[He]2s²2p²

15

N

Nitrogen

15

[He]2s²2p³

16

O

Oxygen

16

[He]2s²2p⁴

17

F

Fluorine

17

[He]2s²2p⁵

18

Ne

Neon

18

[He]2s²2p⁶

25

Mn

Manganese

25

[Ar]3d⁵4s²

26

Fe

Iron

26

[Ar]3d⁶4s²

27

Co

Cobalt

27

[Ar]3d⁷4s²

28

Ni

Nickel

28

[Ar]3d⁸4s²

29

Cu

Copper

29

[Ar]3d¹⁰4s¹

30

Zn

Zinc

30

[Ar]3d¹⁰4s²

31

Ga

Gallium

31

[Ar]3d¹⁰4s²4p¹

32

Ge

Germanium

32

[Ar]3d¹⁰4s²4p²

33

As

Arsenic

33

[Ar]3d¹⁰4s²4p³

34

Se

Selenium

34

[Ar]3d¹⁰4s²4p⁴

35

Br

Bromine

35

[Ar]3d¹⁰4s²4p⁵

36

Kr

Krypton

36

[Ar]3d¹⁰4s²4p⁶

41

Nb

Niobium

41

[Kr]4d⁴5s¹

42

Mo

Molybdenum

42

[Kr]4d⁵5s¹

43

Tc

Technetium

43

[Kr]4d⁵5s²

44

Ru

Ruthenium

44

[Kr]4d⁷5s¹

45

Rh

Rhodium

45

[Kr]4d⁸5s¹

46

Pd

Palladium

46

[Kr]4d¹⁰5s⁰

47

Ag

Silver

47

[Kr]4d¹⁰5s¹

48

Cd

Cadmium

48

[Kr]4d¹⁰5s²

49

In

Indium

49

[Kr]4d¹⁰5s²5p¹

50

Sn

Tin

50

[Kr]4d¹⁰5s²5p²

51

Sb

Antimony

51

[Kr]4d¹⁰5s²5p³

52

Te

Tellurium

52

[Kr]4d¹⁰5s²5p⁴

53

I

Iodine

53

[Kr]4d¹⁰5s²5p⁵

54

Xe

Xenon

54

[Kr]4d¹⁰5s²5p⁶

57-71

Lanthanide Series

72

Hf

Hafnium

72

[Xe]4f¹⁴5d²6s²

73

Ta

Tantalum

73

[Xe]4f¹⁴5d³6s²

74

W

Tungsten

74

[Xe]4f¹⁴5d⁴6s²

75

Re

Rhenium

75

[Xe]4f¹⁴5d⁵6s²

76

Os

Osmium

76

[Xe]4f¹⁴5d⁶6s²

77

Ir

Iridium

77

[Xe]4f¹⁴5d⁷6s²

78

Pt

Platinum

78

[Xe]4f¹⁴5d⁹6s¹

79

Au

Gold

79

[Xe]4f¹⁴5d¹⁰6s¹

80

Hg

Mercury

80

[Xe]4f¹⁴5d¹⁰6s²

81

Tl

Thallium

81

[Xe]4f¹⁴5d¹⁰6s²6p¹

82

Pb

Lead

82

[Xe]4f¹⁴5d¹⁰6s²6p²

83

Bi

Bismuth

83

[Xe]4f¹⁴5d¹⁰6s²6p³

84

Po

Polonium

84

[Xe]4f¹⁴5d¹⁰6s²6p⁴

85

At

Astatine

85

[Xe]4f¹⁴5d¹⁰6s²6p⁵

86

Rn

Radon

86

[Xe]4f¹⁴5d¹⁰6s²6p⁶

89-103

Actinide Series

89

Ac

Actinium

89

[Rn]5f¹6d¹7s²

90

Th

Thorium

90

[Rn]6d²7s²

91

Pa

Protactinium

91

[Rn]5f²6d¹7s²

92

U

Uranium

92

[Rn]5f³6d¹7s²

93

Np

Neptunium

93

[Rn]5f⁴6d¹7s²

94

Pu

Plutonium

94

[Rn]5f⁶7s²

95

Am

Americium

95

[Rn]5f⁷7s²

96

Cm

Curium

96

[Rn]5f⁸7s²

97

Bk

Berkelium

97

[Rn]5f⁹7s²

98

Cf

Californium

98

[Rn]5f¹⁰7s²

99

Es

Einsteinium

99

[Rn]5f¹¹7s²

100

Fm

Fermium

100

[Rn]5f¹²7s²

101

Md

Mendelevium

101

[Rn]5f¹³7s²

102

No

Nobelium

102

[Rn]5f¹⁴7s²

103

Lr

Lawrencium

103

[Rn]5f¹⁴6d¹7s²

104

Rf

Rutherfordium

104

[Rn]5f¹⁴6d²7s²

105

Db

Dubnium

105

[Rn]5f¹⁴6d³7s²

106

Sg

Seaborgium

106

[Rn]5f¹⁴6d⁴7s²

107

Bh

Bohrium

107

[Rn]5f¹⁴6d⁵7s²

108

Hs

Hassium

108

[Rn]5f¹⁴6d⁶7s²

109

Mt

Meitnerium

109

[Rn]5f¹⁴6d⁷7s²

110

Ds

Darmstadtium

110

[Rn]5f¹⁴6d⁸7s²

111

Rg

Roentgenium

111

[Rn]5f¹⁴6d⁹7s²

112

Cn

Copernicium

112

[Rn]5f¹⁴6d¹⁰7s²

113

Uut

Ununtrium

113

[Rn]5f¹⁴6d¹⁰7s²7p¹

114

Fl

Flerovium

114

[Rn]5f¹⁴6d¹⁰7s²7p²

115

Uup

Ununpentium

115

[Rn]5f¹⁴6d¹⁰7s²7p³

116

Lv

Livermorium

116

[Rn]5f¹⁴6d¹⁰7s²7p⁴

117

Uus

Ununseptium

117

[Rn]5f¹⁴6d¹⁰7s²7p⁵

118

Uuo

Ununoctium

118

[Rn]5f¹⁴6d¹⁰7s²7p⁶

119

Uuh

Ununhexium

119

[Rn]5f¹⁴6d¹⁰7s²7p⁶8s¹

120

Uub

Unbium

120

[Rn]5f¹⁴6d¹⁰7s²7p⁶8s²

121

Uut

Ununtrium

121

[Rn]5f¹⁴6d¹⁰7s²7p⁶8s²8p¹

122

Uub

Unbium

122

[Rn]5f¹⁴6d¹⁰7s²7p⁶8s²8p²

123

Uut

Ununtrium

123

[Rn]5f¹⁴6d¹⁰7s²7p⁶8s²8p³

124

Uub

Unbium

124

[Rn]5f¹⁴6d¹⁰7s²7p⁶8s²8p⁴

125

Uut

Ununtrium

125

[Rn]5f¹⁴6d¹⁰7s²7p⁶8s²8p⁵

126

Uub

Unbium

126

[Rn]5f¹⁴6d¹⁰7s²7p⁶8s²8p⁶

127

Uut

Ununtrium

127

[Rn]5f¹⁴6d¹⁰7s²7p⁶8s²8p⁶8d¹

128

Uub

Unbium

128

[Rn]5f¹⁴6d¹⁰7s²7p⁶8s²8p⁶8d²

129

Uut

Ununtrium

129

[Rn]5f¹⁴6d¹⁰7s²7p⁶8s²8p⁶8d³

130

Uub

Unbium

130

[Rn]5f¹⁴6d¹⁰7s²7p⁶8s²8p⁶8d⁴

131

Uut

Ununtrium

131

[Rn]5f¹⁴6d¹⁰7s²7p⁶8s²8p⁶8d⁵

132

Uub

Unbium

132

[Rn]5f¹⁴6d¹⁰7s²7p⁶8s²8p⁶8d⁶

133

Uut

Ununtrium

133

[Rn]5f¹⁴6d¹⁰7s²7p⁶8s²8p⁶8d⁷

134

Uub

Unbium

134

[Rn]5f¹⁴6d¹⁰7s²7p⁶8s²8p⁶8d⁸

135

Uut

Ununtrium

135

[Rn]5f¹⁴6d¹⁰7s²7p⁶8s²8p⁶8d⁹

136

Uub

Unbium

136

[Rn]5f¹⁴6d¹⁰7s²7p⁶8s²8p⁶8d¹⁰

137

Uut

Ununtrium

137

[Rn]5f¹⁴6d¹⁰7s²7p⁶8s²8p⁶8d¹⁰9s¹

138

Uub

Unbium

138

[Rn]5f¹⁴6d¹⁰7s²7p⁶8s²8p⁶8d¹⁰9s²

139

Uut

Ununtrium

139

[Rn]5f¹⁴6d¹⁰7s²7p⁶8s²8p⁶8d¹⁰9s²9p¹

140

Uub

Unbium

140

[Rn]5f¹⁴6d¹⁰7s²7p⁶8s²8p⁶8d¹⁰9s²9p²

141

Uut

Ununtrium

141

[Rn]5f¹⁴6d¹⁰7s²7p⁶8s²8p⁶8d¹⁰9s²9p³

142

Uub

Unbium

142

[Rn]5f¹⁴6d¹⁰7s²7p⁶8s²8p⁶8d¹⁰9s²9p⁴

143

Uut

Ununtrium

143

[Rn]5f¹⁴6d¹⁰7s²7p⁶8s²8p⁶8d¹⁰9s²9p⁵

144

Uub

Unbium

144

[Rn]5f¹⁴6d¹⁰7s²7p⁶8s²8p⁶8d¹⁰9s²9p⁶

145

Uut

Ununtrium

145

[Rn]5f¹⁴6d¹⁰7s²7p⁶8s²8p⁶8d¹⁰9s²9p⁶9d¹

146

Uub

Unbium

146

[Rn]5f¹⁴6d¹⁰7s²7p⁶8s²8p⁶8d¹⁰9s²9p⁶9d²

147

Uut

Ununtrium

147

[Rn]5f¹⁴6d¹⁰7s²7p⁶8s²8p⁶8d¹⁰9s²9p⁶9d³

148

Uub

Unbium

148

[Rn]5f¹⁴6d¹⁰7s²7p⁶8s²8p⁶8d¹⁰9s²9p⁶9d⁴

149

Uut

Ununtrium

149

[Rn]5f¹⁴6d¹⁰7s²7p⁶8s²8p⁶8d¹⁰9s²9p⁶9d⁵

150

Uub

Unbium

150

[Rn]5f¹⁴6d¹⁰7s²7p⁶8s²8p⁶8d¹⁰9s²9p⁶9d⁶

151

Uut

Ununtrium

151

[Rn]5f¹⁴6d¹⁰7s²7p⁶8s²8p⁶8d¹⁰9s²9p⁶9d⁷

152

Uub

Unbium

152

[Rn]5f¹⁴6d¹⁰7s²7p⁶8s²8p⁶8d¹⁰9s²9p⁶9d⁸

153

Uut

Ununtrium

153

[Rn]5f¹⁴6d¹⁰7s²7p⁶8s²8p⁶8d¹⁰9s²9p⁶9d⁹

154

Uub

Unbium

154

[Rn]5f¹⁴6d¹⁰7s²7p⁶8s²8p⁶8d¹⁰9s²9p⁶9d¹⁰

155

Uut

Ununtrium

155

[Rn]5f¹⁴6d¹⁰7s²7p⁶8s²8p⁶8d¹⁰9s²9p⁶9d¹⁰10s¹

156

Uub

Unbium

156

[Rn]5f¹⁴6d¹⁰7s²7p⁶8s²8p⁶8d¹⁰9s²9p⁶9d¹⁰10s²

157

Uut

Ununtrium

157

[Rn]5f¹⁴6d¹⁰7s²7p⁶8s²8p⁶8d¹⁰9s²9p⁶9d¹⁰10s²10p¹

158

Uub

Unbium

158

[Rn]5f¹⁴6d¹⁰7s²7p⁶8s²8p⁶8d¹⁰9s²9p⁶9d¹⁰10s²10p²

159

Uut

Ununtrium

159

[Rn]5f¹⁴6d¹⁰7s²7p⁶8s²8p⁶8d¹⁰9s²9p⁶9d¹⁰10s²10p³

160

Uub

Unbium

160

[Rn]5f¹⁴6d¹⁰7s²7p⁶8s²8p⁶8d¹⁰9s²9p⁶9d¹⁰10s²10p⁴

161

Uut

Ununtrium

161

[Rn]5f¹⁴6d¹⁰7s²7p⁶8s²8p⁶8d¹⁰9s²9p⁶9d¹⁰10s²10p⁵

162

Uub

Unbium

162

[Rn]5f¹⁴6d¹⁰7s²7p⁶8s²8p⁶8d¹⁰9s²9p⁶9d¹⁰10s²10p⁶

163

Uut

Ununtrium

163

[Rn]5f¹⁴6d¹⁰7s²7p⁶8s²8p⁶8d¹⁰9s²9p⁶9d¹⁰10s²10p⁶10d¹

164

Uub

Unbium

164

[Rn]5f¹⁴6d¹⁰7s²7p⁶8s²8p⁶8d¹⁰9s²9p⁶9d¹⁰10s²10p⁶10d²

165

Uut

Ununtrium

165

[Rn]5f¹⁴6d¹⁰7s²7p⁶8s²8p⁶8d¹⁰9s²9p⁶9d¹⁰10s²10p⁶10d³

166

Uub

Unbium

166

[Rn]5f¹⁴6d¹⁰7s²7p⁶8s²8p⁶8d¹⁰9s²9p⁶9d¹⁰10s²10p⁶10d⁴

167

Uut

Ununtrium

167

[Rn]5f¹⁴6d¹⁰7s²7p⁶8s²8p⁶8d¹⁰9s²9p⁶9d¹⁰10s²10p⁶10d⁵

168

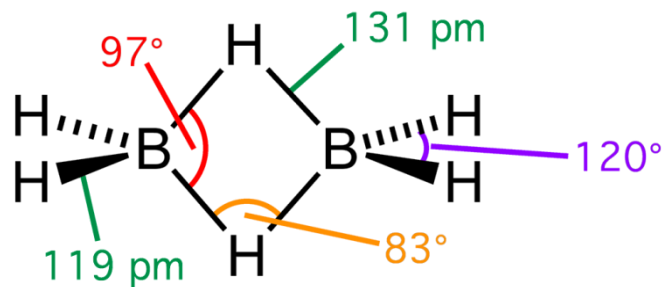
Uub

Unbium

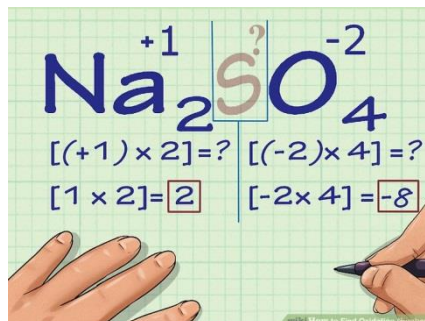
168

[Rn]5f¹⁴6d¹⁰7s²7p⁶8s²8p⁶8d¹⁰9s²9p⁶9d¹⁰

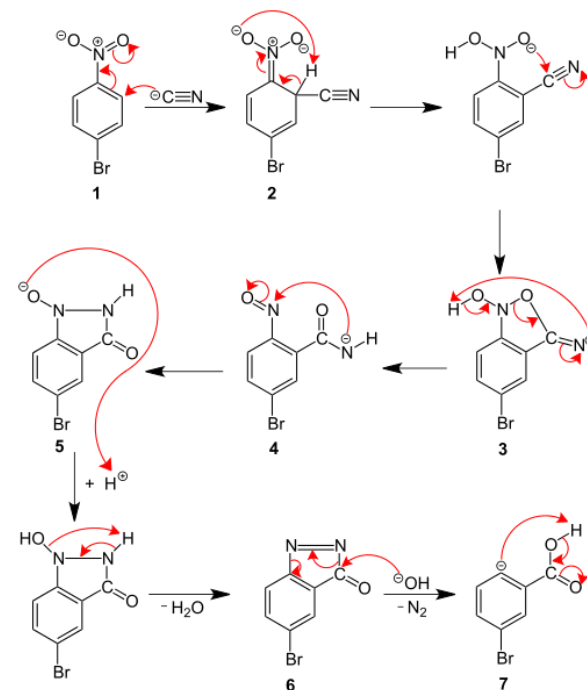
The Chemistry Tool-box



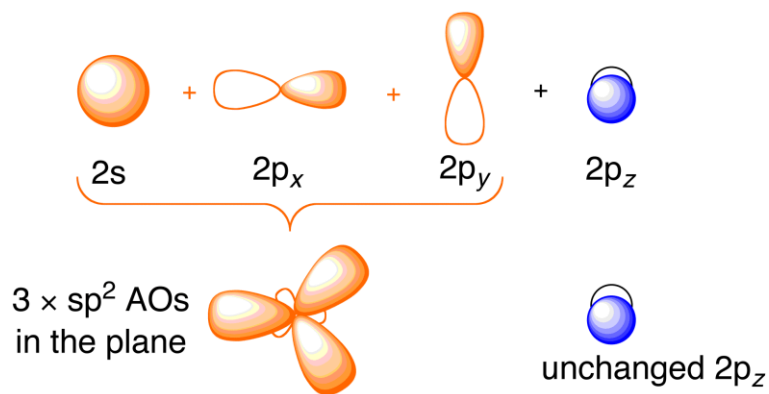
Bonding



Oxidation states



Curley arrows

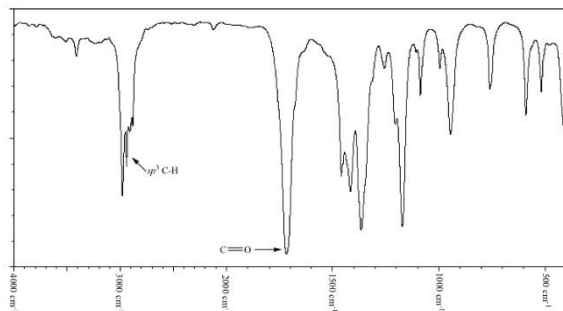


Hybridisation

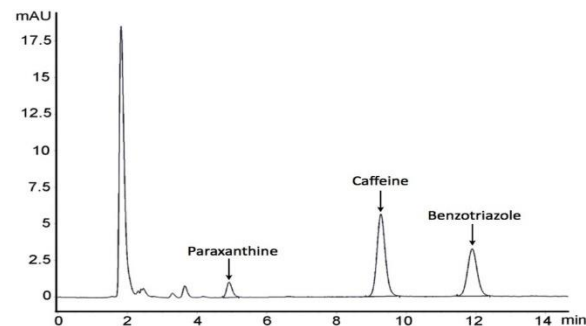
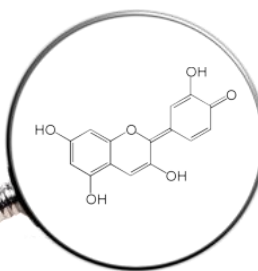
Number of atoms around the central atom (steric number)	0 lone pairs				
	linear	trigonal planar	tetrahedral	trigonal bipyramidal	octahedral
2	180°	120°	109°	90°	90°
3		120°	109°	90°	90°
4			109°	90°	90°
5				90°	90°
6					90°

Valence Shell Electron Pair Repulsion

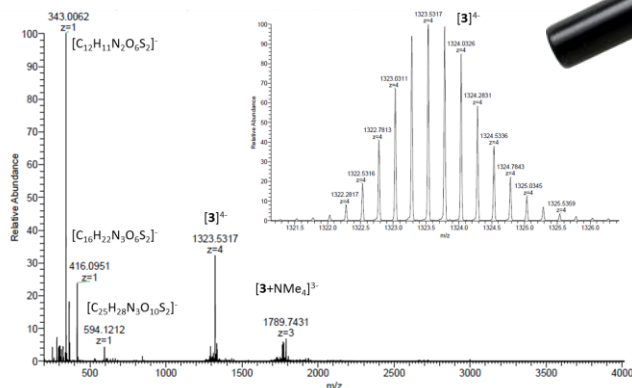
Proof in Chemistry



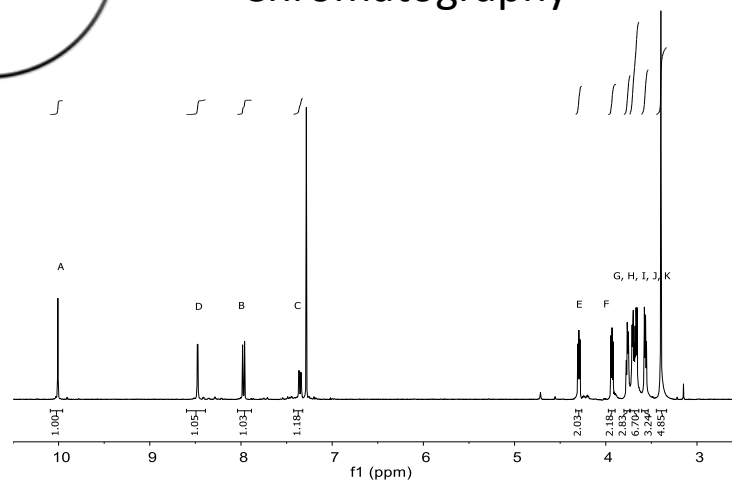
Infrared spectroscopy



Chromatography



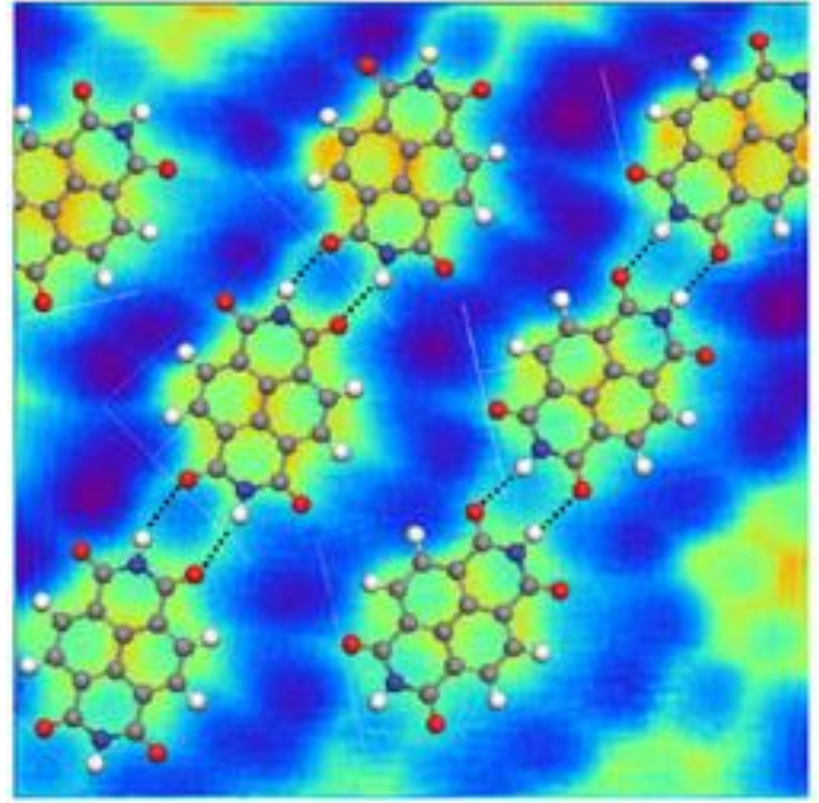
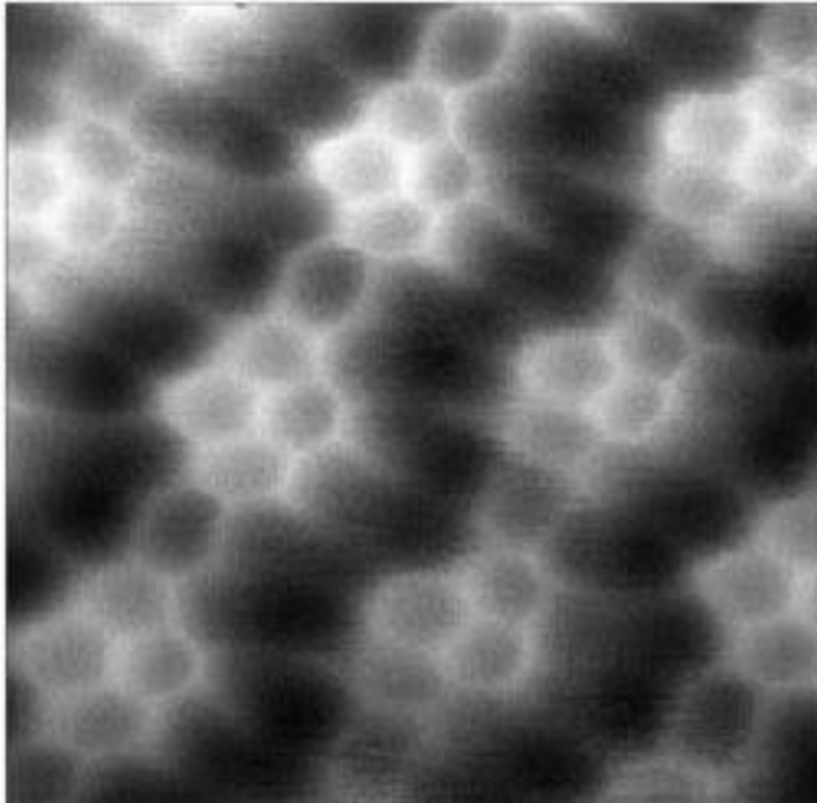
Mass spectrometry



NMR Spectroscopy

“In God we trust; all others bring data.” W. Edward Deming

Seeing is Believing

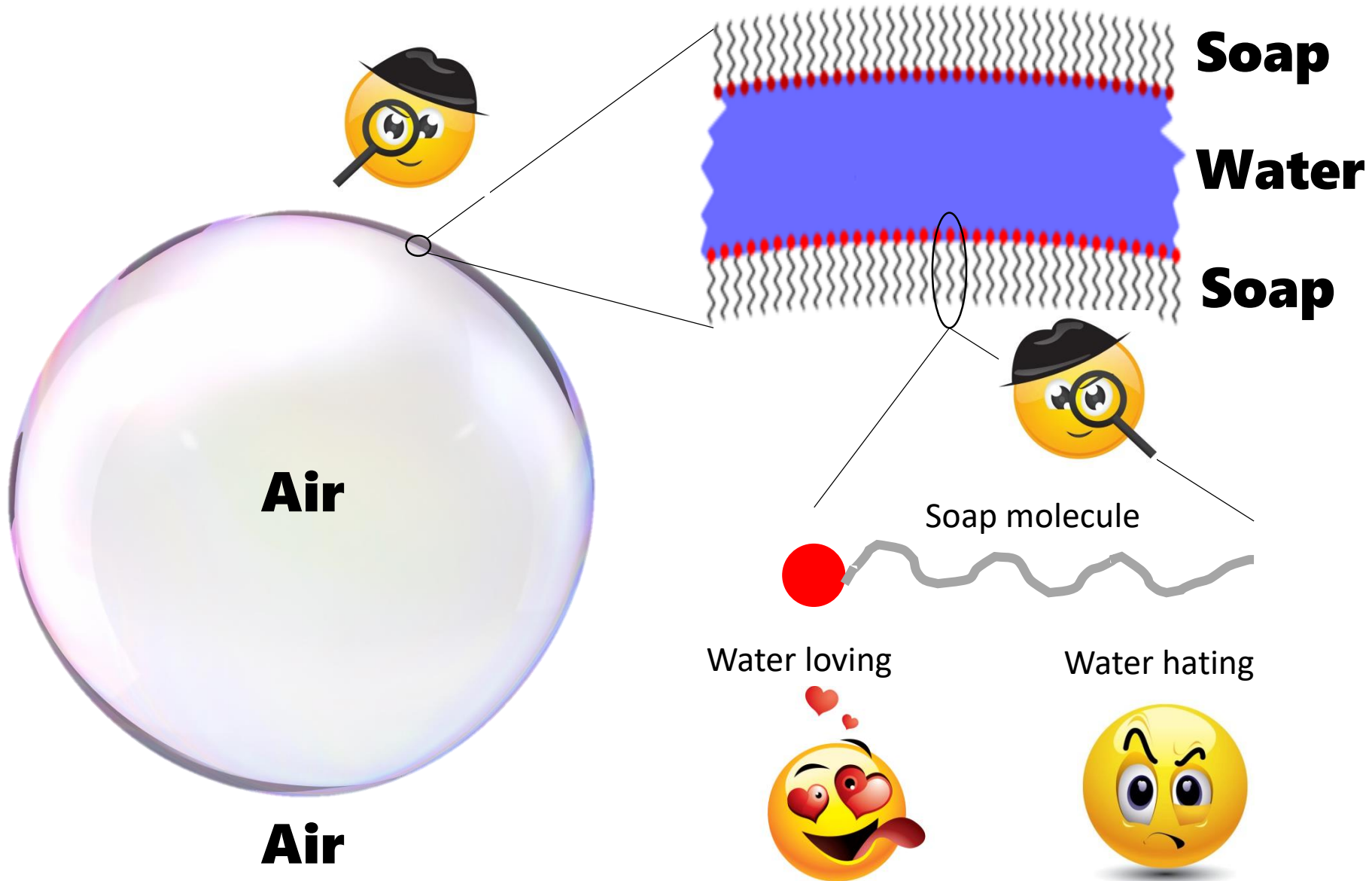




Understanding

Wonder

What are bubbles made of?



If a soap molecule was as big as a beach ball, the bubble would be the size of the earth...

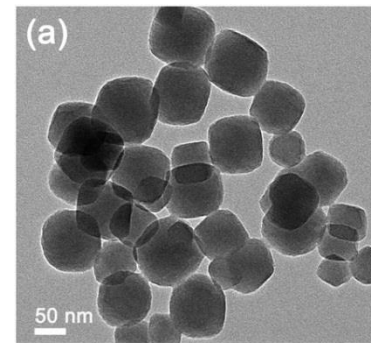
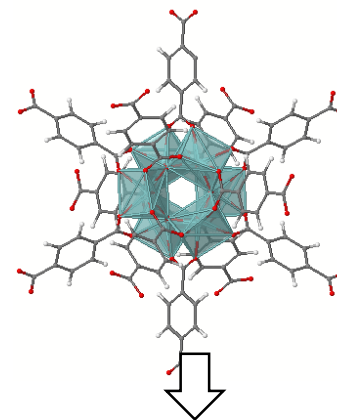
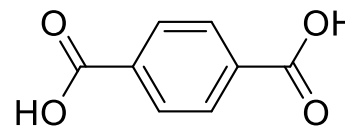
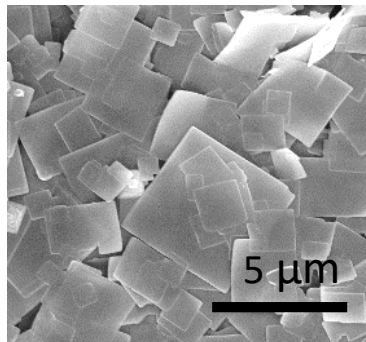
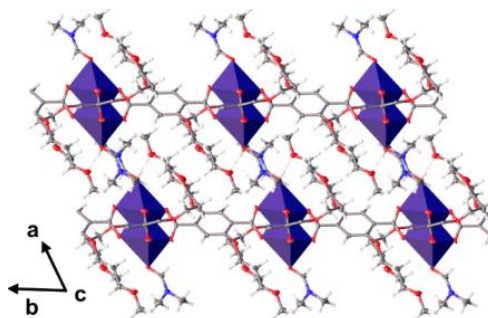
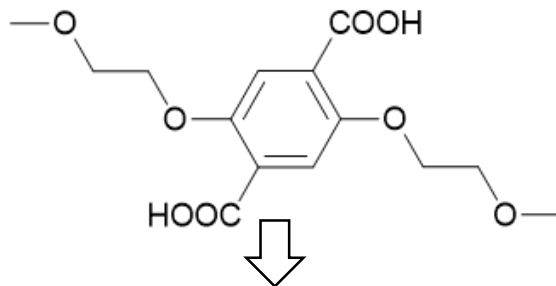
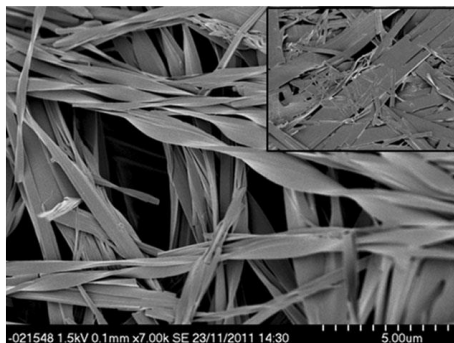
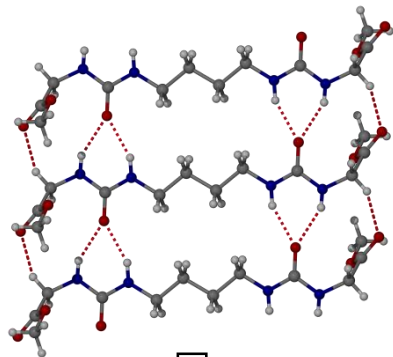
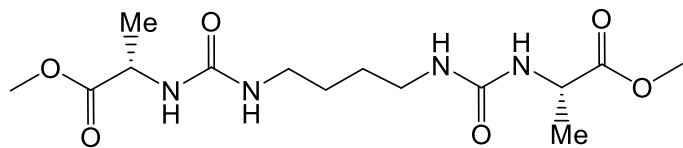


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Molecular Lego



Supramolecular Chemistry



Self-assembly



“We knew of old that God was so wise that He could make all things; but behold, He is so much wiser than even that, that He can make all things make themselves.”

C. Kingsley

A Matter of Perspective

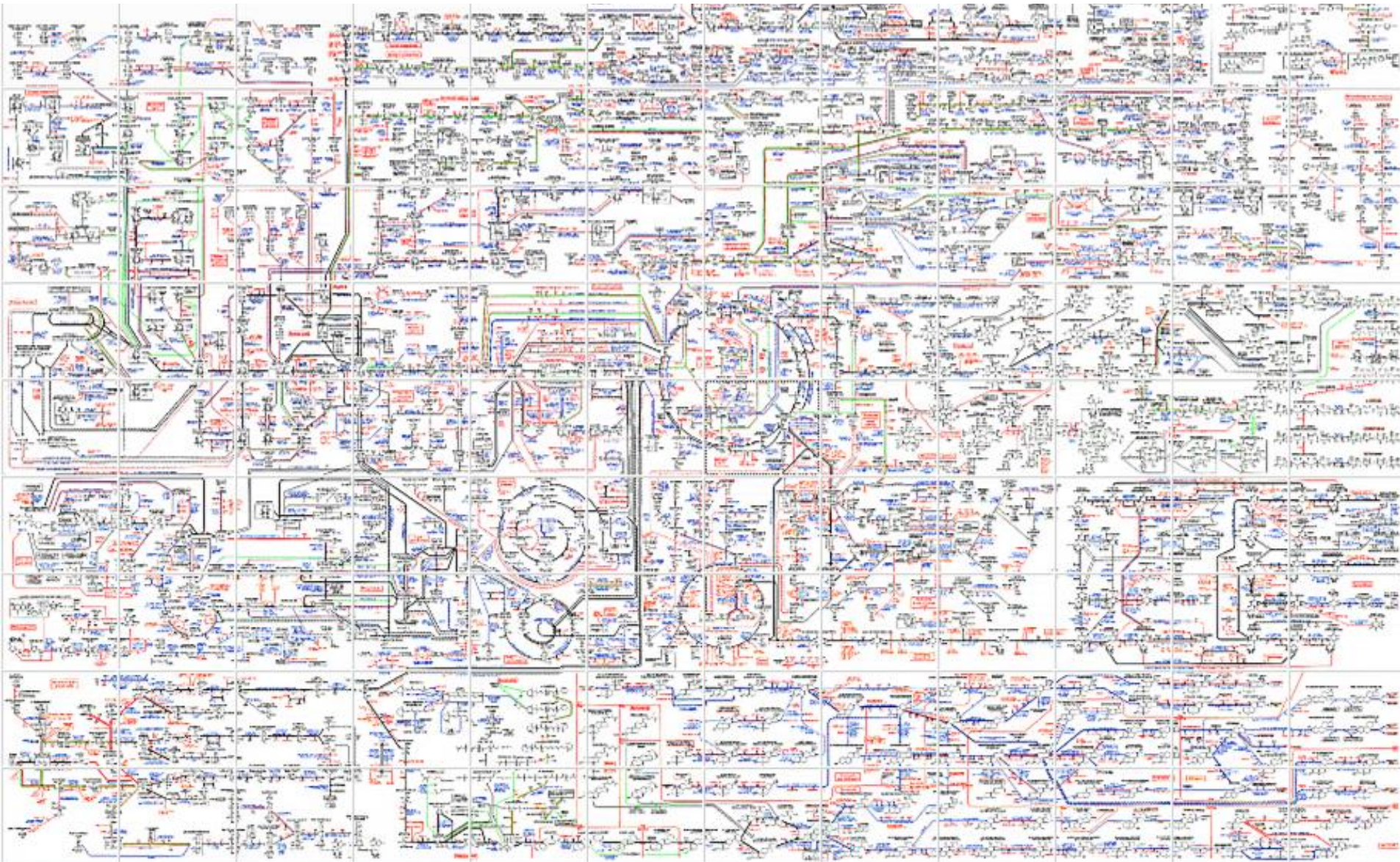
There are more molecules of water in a cup of tea than there are stars in the universe....



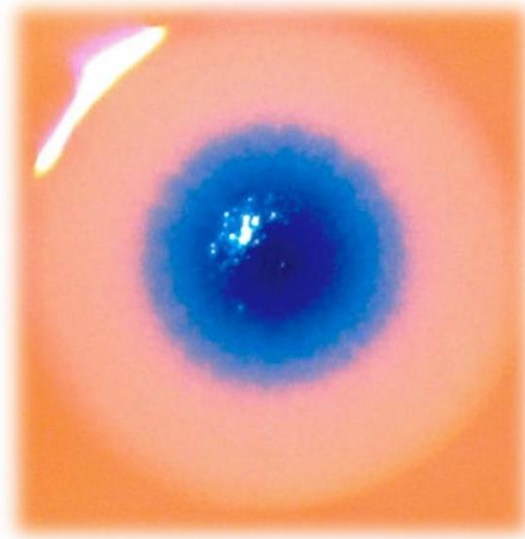
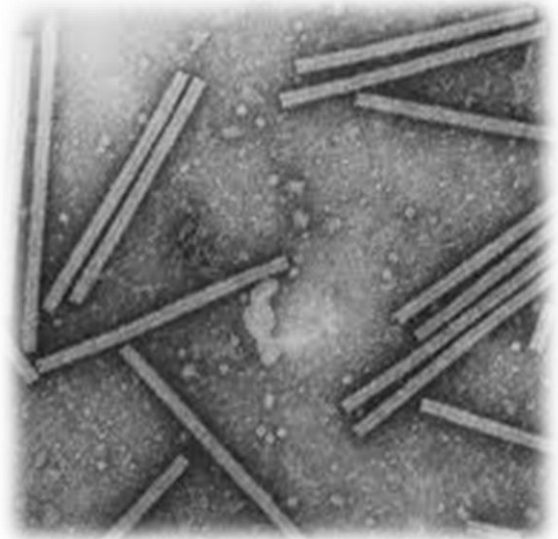
We can observe events which if they were scaled up so that they lasted a second, a second would last the life time of the universe...



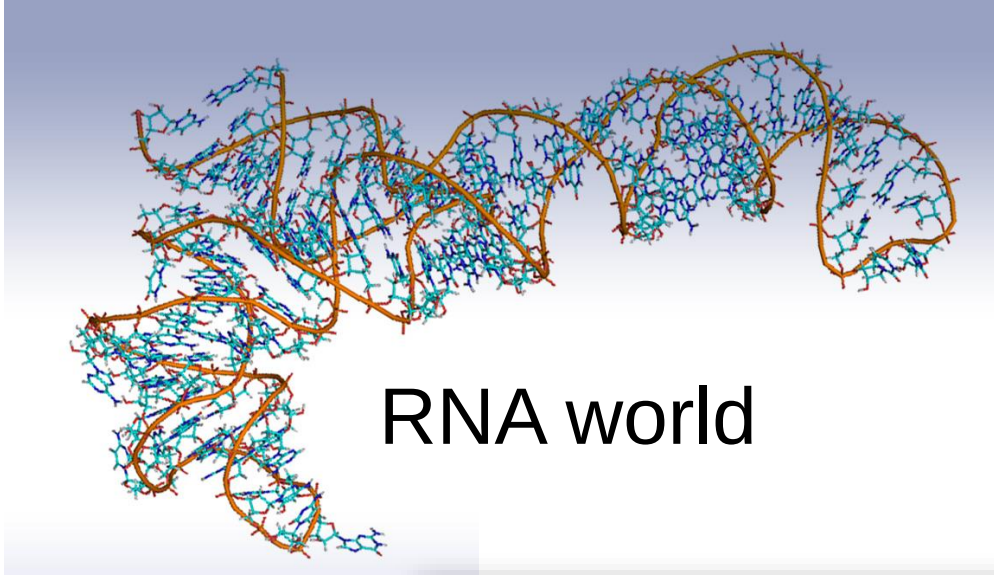
The Chemistry of Life



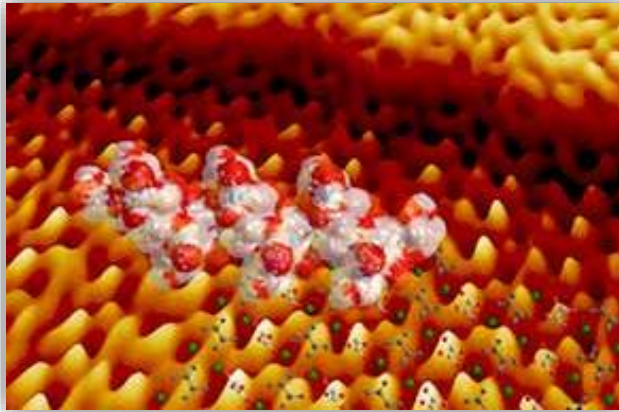
The Edge of Life?



The Origin of Life

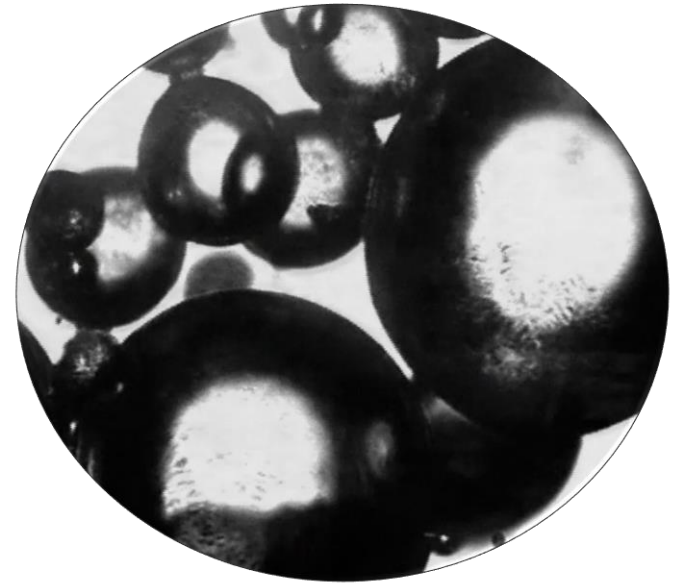


RNA world

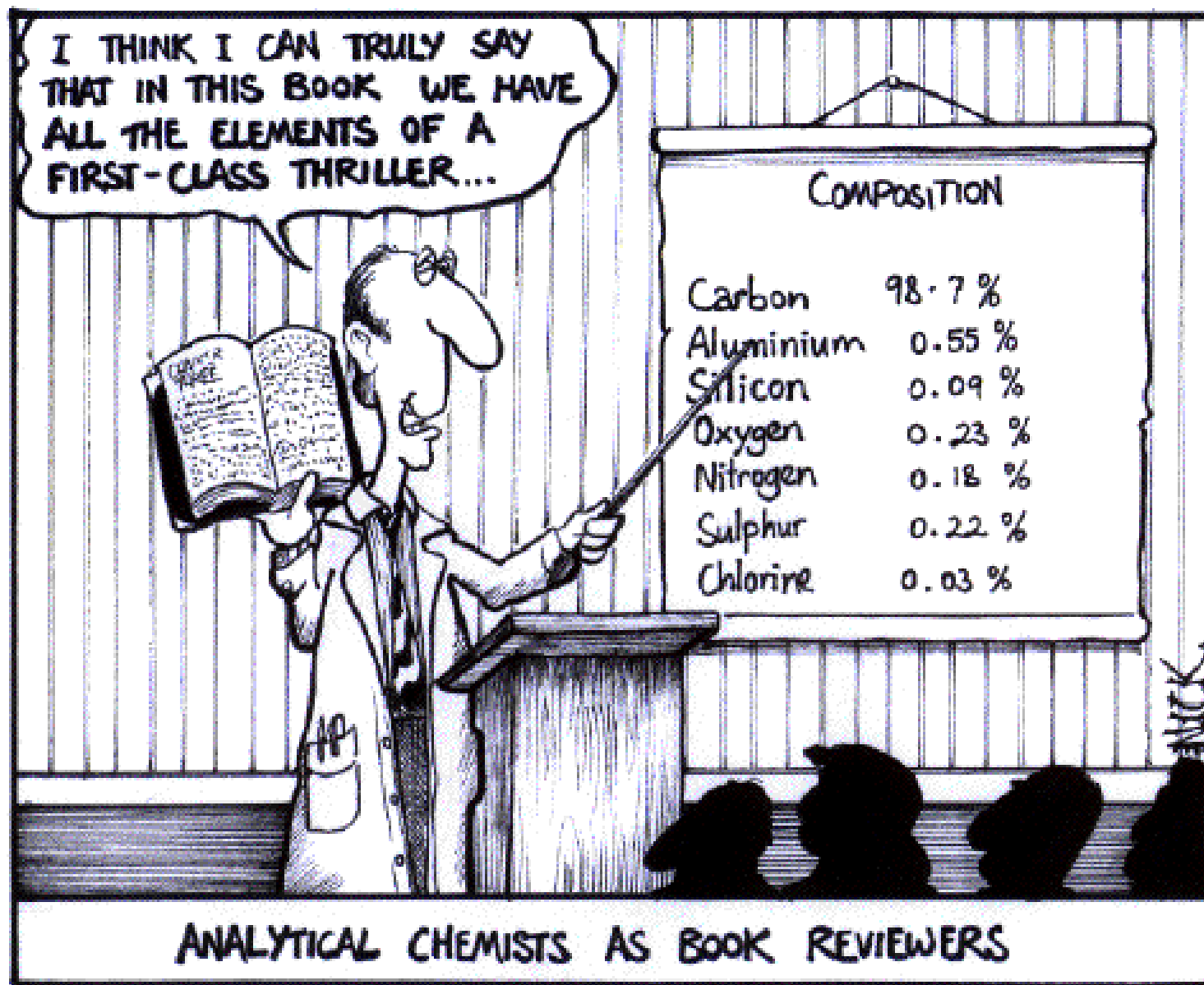


Clay Theory

Hypercycles



Are we *just* a bag of chemicals?



A Chemists Perspective...

Periodic Table of the Elements

The image shows a standard periodic table of elements. It is organized into rows (periods) and columns (groups). Elements are color-coded: metals are in shades of blue and grey, non-metals in shades of green and yellow, and noble gases in pink. The table includes element symbols, names, and atomic numbers. A legend at the top indicates 'Solid, Liquid or Gas' and 'Atomic Number'.

Elegant complexity



Design



Recalibrate



Consistent

... on Science and Faith

Any Questions?

