6. Dictionary of Interesting Chemistry

Summary

Outline of the exercise

Students work in pairs to produce an entry for a new publication called *The Dictionary of Interesting Chemistry*. They are given a title, and are required to locate four references in order to produce an entry of about 300 words. Clues for the references are given, and will help them gain confidence in the use of BIDS and *Chemical Abstracts*. Although students are not required to analyse the papers in depth, they need to discern the key results and summarise them effectively in a high quality, illustrated dictionary entry. Some examples of work produced by students during trialling of the exercise are included in this book.

Key aims

- to introduce the commonest methods of literature searching; and
- to develop the ability to summarise information concisely.

Time requirements

- Optional introduction to BIDS and *Chemical Abstracts* (approximately 1 hour)
- Less than 1 hour (tutor contact time)
- Approximately 20 hours private study

Timetable

Students might need an introduction to the use of *Chemical Abstracts* and BIDS. However, once they have received guidance on the use of the databases, only 5 minutes are required to explain the exercise; details can be found on the student handout. Students need about 20 hours to complete the exercise well, including 5 hours for finding the correct references, 7 hours for reading the papers and extracting the key information, and 8 hours for producing their dictionary entry in the correct format. Some students might need help from the tutor to locate their references. A reasonably imminent deadline is helpful – if students have other course commitments, a timescale of 2 weeks is appropriate.

S6 Dictionary of Interesting Chemistry

In this exercise you are required to produce an entry for the *Dictionary of Interesting Chemistry* that is to be published shortly. It will include some of the most interesting compounds, reactions, advanced materials, devices, and observations relating to chemistry. Examples include:

Compounds	anatoxin, cis-platin, nitric oxide, buckminsterfullerenes
Reactions	Wacker Process, photodissociation, polymerisation
Advanced Materials	liquid crystals, gels, dendrimers
Devices	microwaves, electrospray mass spectrometry
Observations	ozone hole, comets, the chemistry of odour

The entry should be about 300 words (with absolute limits of 200–400 words), including one graphic drawn by you (eg a chemical structure or scheme); one additional graphic (in any format) may also be added. It must fit on a side of A4, with typing in single-spaced 12 point Times font.

Each entry into the dictionary requires four references from primary journals, although a further review article or book reference may be added. Clues are given to guide you to three of the primary references, and a fourth reference must be chosen by you. The clues might include:

- the first time the topic was published;
- a key paper by one of the main researchers; and
- one particularly interesting aspect of the topic, possibly a recent development.

The entry is to be pitched at the level of a chemist with an undergraduate degree – so you should be able to fully understand each other's entries in the dictionary. A typical entry might include:

Introduction (50 words)
eg Aspirin remains one of the most widely used painkillers. Despite having being developed about 100 years ago, new uses of the drug are still being discovered today, and interest in it has been renewed by its recent success in the treatment of stroke.
Discovery/Background (100 words)
Summary of the Chemistry (*eg* reactions, properties, applications) (150 words)
New aspect or unusual feature (100 words)

Sometimes scientific papers can be quite daunting, but you are not required to read them in detail. Just locate them and pick out the main observations, so that you (or others) can follow up on the details if necessary. A good textbook, appropriate dictionary (*eg* Dictionary of Organic Compounds), or good review article will provide a lot of the general information you need.

Topics and Clues

Topic 1

Microwave Synthesis

Your entry into the *Dictionary of Interesting Chemistry* must cover the application of microwave dielectric heating to the synthesis of solid-state materials, and its advantages over conventional methods. The report should include reference to the use of domestic ovens.

Reference one	*Nature* 1988, first author DRB.
Reference two	Same group, same year – an RSC journal.
Reference three	*Chemical Communications*, 1996. Authors W and B.

Topic 2

$Rh_4(CO)_{12}$

Your entry into the *Dictionary of Interesting Chemistry* must describe this important binary carbonyl compound including the original synthesis, determination of its interesting structure and its catalytic applications.

Reference one	Booth *et al.*, 1968.
Reference two	Wei, the next year.
Reference three	Japanese workers in 1991 using $Rh_4(CO)_{12}$ for a selective synthesis of what?

Topic 3

Anatoxin

Your entry into the *Dictionary of Interesting Chemistry* must cover the isolation, structure, pharmacology and one recent asymmetric synthesis of this toxin.

Reference one	What is the structure, and what does the acronym VFDF stand for? Try Devlin 1977.
Reference two	How does it kill you? Try vol. 135 of a 1987 pharmacology journal.
Reference three	What is the yield of a recent synthesis? Try Skrinjar, 1992.

Topic 4

Biological Applications of Poly(diacetylenes)

Your entry into the *Dictionary of Interesting Chemistry* must cover the detection of the influenza virus by functionalised PDAs. You need to describe the synthesis of PDAs and find the first use of them to detect the 'flu virus. Include the detection method used and illustrate their usefulness by describing further applications.

Reference one	American chemistry journal. 1993, authors include DHC.
Reference two	Same group, same journal, 1995.
Reference three	More recently, the same group, but in a journal with a medical leaning.

Topic 5

Main-chain Thermotropic LCPs

Your entry into the *Dictionary of Interesting Chemistry* must:

- define the key terms – LCP, thermotropic, main-chain;
- indicate the first synthesis of this class of compounds; and
- identify their useful properties and how they relate to applications.

Reference one	1975, authors AR and AS.
Reference two	1976, authors WJJ and HFK.
Reference three	Late 1980s by a single author, in a polymer journal with an engineering slant.

Topic 6

Anisotropic Gels

Your entry into the *Dictionary of Interesting Chemistry* must describe the operating principle and primary application of these materials, which consist of low molecular weight liquid crystal (LC) containing a small proportion of networking agent. Also find a reference which describes their use with conventional LCs.

Reference one	1990, a physics journal, author RAMH.
Reference two	1992, same journal, 4 authors including Kim.
Reference three	Same journal, RAMH with another, early 1990s.

Topic 7

Photodissociation of Methane

Your entry into the *Dictionary of Interesting Chemistry* must describe the primary photodissociative channels in the photodissociation of methane in the vacuum UV region (100–300 nm). A number of possible reactions can occur which will produce CH_3 radicals, or CH_2 (methylene) with H or H_2. The key references show the development of the understanding of these processes.

Reference one	1962, authors' surnames M and M.
Reference two	1982, same journal, authors S and Black.
Reference three	Same journal, 8 authors including Morley, 1990s.

Topic 8

Cyclobutadiene

Your entry into the *Dictionary of Interesting Chemistry* must discuss the instability of free cyclobutadiene and explain how its co-ordination to metal complexes brings stability. Describe how complexes have been isolated and give the structure and reactivity of the co-ordinated ring.

Reference one	1956, in a journal of the Royal Society of Chemistry.
Reference two	1965, in the American equivalent.
Reference three	1975, author RP.

Topic 9

Vinyl Benzoate Polymerisation

Your entry into the *Dictionary of Interesting Chemistry* must discuss this anomalous reaction, briefly describing the type of polymerisation that is occurring.

Reference one	1959, Polymer journal – try a radical search!
Reference two	1949, it all starts from this.
Reference three	1959, a journal for big molecules. Authors V and S.

Topic 10

Suaveoline

Your entry into the *Dictionary of Interesting Chemistry* must cover the isolation, biosynthesis and the first total synthesis of this natural product.

Reference one	1972, journal name is 'TL'; suaveoline is an alkaloid.
Reference two	Phytochemistry journal, Enders (or Endress in BIDS) *et al* in the 1990s.
Reference three	Mid 1990s, authors B and M.

Topic 11

Odour-Structure Relationships

Your entry into the *Dictionary of Interesting Chemistry* must comment on odour characteristics and how these relate to molecular structure. Describe the methods that are used to study this relationship (remember the American spelling).

Reference one	1967, a general scientific journal.
Reference two	1971, another general scientific journal, authors GFR and JIH.
Reference three	1992, pharmaceutical journal. Authors include LBK.

Topic 12

FR-900848

Your entry into the *Dictionary of Interesting Chemistry* must give the full structure and absolute stereochemistry of this antifungal antibiotic (it may be referred to as an antifungal agent), which were recently confirmed by elegant synthetic studies. Discuss the following: its source, biological activity and physicochemical properties.

Reference one	1990, authors are Yoshida *et al.*
Reference two	Barrett *et al* in 1995 describe approaches to the synthesis; AJPW is a co-author.
Reference three	The following year, successful synthesis in American journal.

Topic 13

Cis-Platin

Your entry into the *Dictionary of Interesting Chemistry* must give this compound's structure and describe its primary application. Note its interaction with a key biological molecule and the development of related compounds for the same purpose.

Reference one	1969, in a general scientific journal. Search for anti-cancer agents.
Reference two	mid-1980s, Lippard and others in another general scientific journal.
Reference three	Early 1990s, same author with two others, reviews this topic for inorganic chemists.

Topic 14

Polymer Dispersed Liquid Crystals

Your entry into the *Dictionary of Interesting Chemistry* must describe how the operation of displays incorporating these novel materials differs from those using conventional liquid crystals, and the advantages over LCDs. Explain how changes to the preparation methods and composition affect the physical form of the materials, which in turn affects the switching behaviour. Explain why they perform so poorly at certain frequencies of electric field. (NB: Early papers may refer to these materials by different names).

Reference one	1986, a physics journal, author Doane and three others.
Reference two	1994, chemistry journal, 3 authors including Amundson.
Reference three	Polymer journal, primary author's initials are ZZZ, 1992.

Topic 15

Danishefsky's Diene

Your entry into the *Dictionary of Interesting Chemistry* must describe the structure of this diene and its reactions with alkenes, carbonyls and imines (all acting as what?).

Reference one	An American journal. 1974, look for the man himself!
Reference two	It's him again – same journal, 1982 with JFK and SK.
Reference three	Same journal in the 1990s, but with new authors including KI and Yamamoto

Topic 16

Reversible Oxygen Carriers

Your entry into the *Dictionary of Interesting Chemistry* must cover the principles behind the development of complexes which are capable of binding reversibly with O_2. Compare this to the naturally occurring complex and consider why the workers in this area adopted the structures of the various complexes selected.

Reference one	1973, American journal.
Reference two	Same journal – Busch and others in 1983.
Reference three	Large molecule journal in 1988 with 4 authors including MO and HN.

Topic 17

Liquid Crystalline Metal Complexes

Your entry into the *Dictionary of Interesting Chemistry* must cover the structural types of metal complexes found in liquid crystalline (LC) systems and the reasons why metal complexes containing LCs (known as metallomesogens) are interesting.

Reference one	Nolte and others wrote this in 1988, in a Dutch journal.
Reference two	1991, two more transition elements (d^3 and d^8), Hoshino *et al.*
Reference three	1993, German journal – MJB *et al.* report which 'first'?

Topic 18

Electrospray Ionisation

Your entry into the *Dictionary of Interesting Chemistry* must cover the discovery of electrospray ionisation, including a brief summary of the principle. Also state the sensitivity of the technique and one recent application.

Reference one	Yamashita and colleague in 1984.
Reference two	1994, Emmett and RMC.
Reference three	1996 Clinical journal – author Sweetman.

Topic 19

Comets and the Origins of Life

Your entry into the *Dictionary of Interesting Chemistry* must describe how the impact of comets on the Earth's surface might have caused the basic building blocks of life to form. The papers relate to how comets colliding with Earth could have led to atmospheric chemistry from which organisms evolved.

Reference one	Mid 1980s paper, general science journal, BF plus 3 co-authors.
Reference two	Mid 1990s, a space journal, authors JO, TM and AZ.
Reference three	Late 1990s, another general science journal, authors CPM and WJB.

Topic 20

Ionic liquids

Your entry into the *Dictionary of Interesting Chemistry* must discuss the important qualities these liquids exhibit, the synthetic route to them, and their uses. You should also include recent developments concerning room temperature ionic liquids.

Reference one	Early 1980s, inorganic journal, first author JSW.
Reference two	A technology journal, 1990s, author KRS.
Reference three	A recent communication (late 1990s) by 5 authors.

Topic 21

Transition Metal σ-complexes

Your entry into the *Dictionary of Interesting Chemistry* must explain why transition metal σ-complexes are important models for the study of the activation (oxidative addition) of CH_4. Give a simple description of the bonding in such systems in molecular orbital terms and identify which heavier analogue of CH_4 has recently been characterised in a σ-complex.

Reference one	1984, American journal. Five authors including Swanson.
Reference two	Same journal, same year. Authors J-YS and RH.
Reference three	1995, same journal, but only two pages. Five authors, including Burns.

Topic 22

The Isomerisation of Carboranes

Your entry into the *Dictionary of Interesting Chemistry* must describe the mechanism of the isomerisation of icosahedral carboranes, which appears to be finally established; comment on the other major contributions over thirty years of speculation

Reference one	DG and JD publish important paper on carborane chemistry in 1963.
Reference two	Thirty years later, important calculations by Wales identify potential intermediates.
Reference three	1997, the first experimental proof of a mechanism is reported in a German journal by SD and others.

Topic 23

Nitric Oxide

Your entry into the *Dictionary of Interesting Chemistry* must answer the following questions concerning NO. In 1987, two groups, one led by Moncada, found that NO is an essential molecule in living organisms; who were the other groups, what does NO do, and what is its medical importance?

Reference one	1987, key publication by Moncada, with AGF and another as co-authors.
Reference two	DLHW and ARB review in 1993.
Reference three	1996 – Rossaint *et al.* describe NO in an enzyme-related journal.

Topic 24

Taxol

Your entry into the *Dictionary of Interesting Chemistry* must cover the source, biological activity, structure and physicochemical properties of taxol. Describe the mechanism of cytotoxicity, the source of the material and the dilemma attached to this. Find a total synthesis of this natural product and comment on the viability of the current source of supply.

Reference one	Authors Wani *et al* in the early 1970s.
Reference two	Review up to 1993 by Nicolaou and two colleagues.
Reference three	1994 was a first, reported by Holton *et al.* in two consecutive papers.

Topic 25

Organometallic Complexes of C_{60}

Your entry into the *Dictionary of Interesting Chemistry* must cover the development of the organometallic chemistry of C_{60}. Compare its behaviour to that of an electron deficient alkene or arene.

Reference one	Suggested phrases for searching: mono adduct, $[(C_6H_5)_3P]_2Pt$ and C_{60}; PJF *et al.*
Reference two	$Ir(PPh_3)_2$ and C_{60}; ALB *et al.*
Reference three	A 1996 paper, comparing C_{60} to an arene in its bonding.

Topic 26

Symmetric Chlorine Dioxide

Your entry into the *Dictionary of Interesting Chemistry* must outline its preparation, detection in the stratosphere, and briefly describe its role in ozone depletion.

Reference one	RHD and colleague in 1953, try searching under chlorine(IV) oxide.
Reference two	1994, in a journal covering chemistry and physics, authors SH and JBN lead the way to its detection.
Reference three	1987, not a chemistry journal. Authors SS, GHM, RWS and ALS build on the previous work to find the answer.

Topic 27

Dendrimers

Your entry into the *Dictionary of Interesting Chemistry* must identify the nature of the structures, their unique aspects as large macromolecules of well defined molecular weight and the way in which these structures are synthesised.

Reference one	1990, a major paper with 170 references written by DAT and others.
Reference two	Same year, an alternative synthetic approach by Hawker and another.
Reference three	In the title of this slightly later paper, alternative names are included. Try arborols and cascade molecules; authors include HBM.

Topic 28

Ascaridole

Your entry into the *Dictionary of Interesting Chemistry* must cover the isolation, synthesis, pharmacological properties and rearrangement reactions of ascaridole.

Reference one	1971 paper by Bernhard *et al.*, in a biological journal.
Reference two	1953 paper by GOS, KGK and HJM.
Reference three	1979 paper brings more light to the chemistry of ascaridole. Two of the four authors have colourful names.

Topic 29

Artemisinin

Your entry into the *Dictionary of Interesting Chemistry* must cover its isolation, synthesis and pharmacological properties.

Reference one	1990s paper co-authored by Butler gives a general view.
Reference two	1980 paper with unspecified authors, determines the structure unambiguously.
Reference three	Elaboration of optically-active terpene precursor provides alternative route to title compound in early 1990s; 3 authors, including MAA in a chemical journal.

Topic 30

The Wacker Process

Your entry into the *Dictionary of Interesting Chemistry* must describe the conversion of ethene to ethanol and give details of the catalysts required (and their role in the reaction) and the optimum conditions.

Reference one	1959 paper with seven authors including Hafner, make the first progress using the Wacker catalysts.
Reference two	1962 paper gives more from the same team in the international edition of Reference one.
Reference three	1984, Japanese author adds the required details, in a review article. Search using the relevant metal.

T6 Dictionary of Interesting Chemistry

This exercise is designed to be run soon after students have been introduced to literature searching for the first time. Input might come from library staff or an expert on information services, who often provide training sessions, videos and advice on the facilities available at a particular institution.

The exercise seems to work best if the students work in pairs, although it could easily be carried out individually. However, students gain confidence from working together on the information retrieval and they often produce higher quality submissions if they can critically discuss their entry. The allocation of suitable topics to pairs of students needs some preparation by the tutor.

Once the topics have been allocated tutor input is minimal, although additional clues can be given to students who are struggling (see notes below). The length of the report that is suggested in the student handout is deliberately short, as this exercise was designed to develop strategies for information retrieval. Moreover, the ability to produce short, clear summaries is a valuable skill.

Topics

Thirty topics are suggested, for which the following information is provided:

- Handouts for students on each of the thirty topics;
- A list which can be used to allocate titles to students (see next page);
- Notes on where each of the clues leads (see Appendix B); and
- The three references for each topic (see Appendix B).

By asking colleagues to contribute one (or two) new titles, and three appropriate references, additional topics can be generated.

Databases and journals

Although the exercise has been designed for *Chemical Abstracts* (in hard copy form) and BIDS (Bath Information Database Service), its framework can be adapted to introduce additional resources such as safety databases, CD-ROMs, other chemistry resources such as Beilstein and Gmelin, and the World Wide Web.

If students are expected to produce an extensive report, it will be necessary to check the availability of all of the referenced journals. Otherwise, the abstracts in BIDS or *Chemical Abstracts* are likely to contain the key points of the paper and will provide enough material for a shorter (approximately 300 word) report.

Student examples

Two examples of dictionary entries produced by students undertaking the exercise are included; whilst not perfect, they indicate the sort of entries that might reasonably be expected.

Titles of dictionary entries

Topic	Student(s)	Title of assigned topic
1		Microwave synthesis
2		$Rh_4(CO)_{12}$
3		Anatoxin
4		Biological applications of PDA
5		Main-chain thermotropic LC polymers
6		Anisotropic gels
7		Photodissociation of methane
8		Cyclobutadiene
9		Vinyl benzoate polymerisation
10		Suaveoline
11		Odour-structure relationships
12		FR-900848
13		Cisplatin
14		Polymer dispersed liquid crystals
15		Danishefsky's diene
16		Reversible O_2 carriers
17		LC-metal complexes
18		Electrospray ionisation
19		Comets and the origins of life
20		Ionic liquids
21		Transition metal sigma-complexes
22		The isomerisation of carboranes
23		Nitric oxide
24		Taxol
25		Organometallic complexes of C_{60}
26		Symmetric chlorine dioxide
27		Dendrimers
28		Ascaridole
29		Artemisinin
30		The Wacker process

Assessment

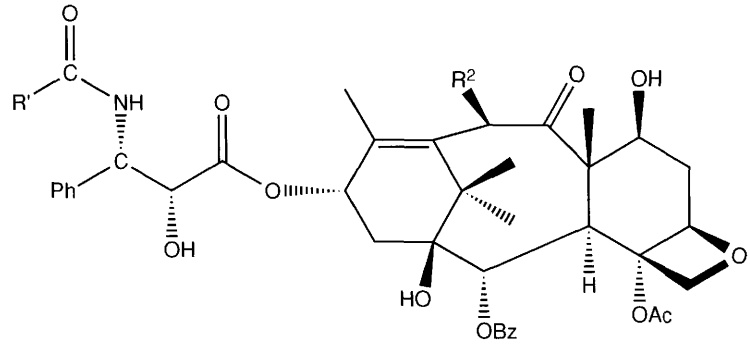
Tutor assessment is fairly straightforward and an appropriate assessment form is included in this pack. If the students can see each other's work their entries tend to be of a higher standard, especially if they are compiled into a 'Dictionary'. Peer-assessment can also be carried out, but it is important that a significant portion of the mark is set aside for location of the correct references.

Examples of student work

Taxol

has potent antileukemic and tumor inhibitory properties and is isolated from the stem bark of the Pacific yew, *Taxus brevifolia*. First isolated in 1969, the cytotoxic behaviour was first reported by Wani and Hall[1] with the first total synthesis reported independently by Nicolaou[2] and Holton[3]. It has recently completed its clinical trials and is used in the treatment of breast and ovarian cancer. [4]

All plant and animal cells that have a nucleus, contain a protein called tubulin, the purpose of which is to form microtubules, which act as cell templates and push apart dividing cells. Most ordinary body cells divide only very infrequently, whereas cancer cells divide very rapidly. Taxol unlike other anti-cancer agents actually stimulates the formation of microtubules but still inhibits cell division.



1. Taxol, R^1 = Ph, R^2 = OAc 2. Taxotere, R^1 = ^{t}BuO, R^2 = OH

The Pacific yew tree from which taxol is derived is slow growing, small in height and therefore approximately 3000 trees are required per kilogram, enough to treat only 500 patients. As a result alternative sources have been sought in the form of Taxotere (essentially taxol but with a different side chain protecting group at nitrogen), currently produced synthetically by adding a side chain to 10-deacetyl baccatin III, which is readily available from the renewable needles of the European yew, *T. bacatta*.

1. M.C. Wani *et al.*, *J. Am. Chem. Soc.*, 1971, **93**, 2325.

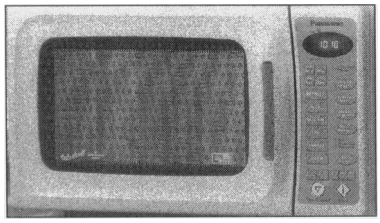
2. K.C. Nicolaou *et al.*, *Angew. Chem. Int. Ed. Engl.*, 1994, **33**, 15.

3. R.A. Holton *et al.*, *J. Am. Chem. Soc.*, 1994, **116**, 1597.

4. P. Jenkins, *Chem. Br.*, 1996, **32**, 43.

Dawn Robinson and Trish Drennan

Microwave Synthesis



It has been known for a long time that we can use electromagnetic waves to bring molecules into excited rotational states, this aspect of physical chemistry being utilised domestically in the microwave oven to heat food. However, some years ago, chemistry took the discovery and put it back into the hands of the scientist to heat their reactions. Since this first step many reactions have been conducted using microwave ovens, domestic and specially designed, with very intriguing results.

We know that water molecules are the target of the domestic oven but any molecule with a permanent dipole is susceptible. The average time taken to rotate a molecule through one radian (correlation time) is similar enough in most molecules to be excited by the frequency of the domestic microwave 2.45 GHz. The microwave energy is efficiently changed into heat and superheating is easily achieved at quite low pressures. This can give amazing improvements in rates of reactions of organic species eg the Diels-Alder reaction of maelic anhydride with anthracene in diglyme (bp 162 °C) takes one minute in the microwave and gives 90% product whereas it would take ~90 minutes conventionally.

In the solid state, coupling to microwaves is not usually observed but conducting and semiconducting solids can couple through the movement of electrons or ions. As the temperature increases the efficiency of coupling increases, so temperature increases further and so on until a thermal runaway is observed. This leads to melt but when the microwaves are switched off the solid cools very quickly. This technique can be used to create high temperature ceramic superconducting materials.

Many of the inorganic oxides from which the ceramics are made do not absorb microwaves, but some of them do (see table 1), meaning a reaction mixture of some absorbent types mixed with transparent ones will still heat very rapidly. Where conventional techniques could take from 12–24 hours, the microwave method of melt and quench can produce pure samples in a matter of minutes.

Table 1

MW absorbing	**MW Transparent**
ZnO	CaO
V_2O_5	TiO_2
CuO	Al_2O_3
MnO_2	Fe_2O_3

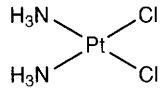
By the amazing claims suggested in chemical literature, it is obvious that this area of chemistry could prove to be of significant importance in the future of chemical synthesis.

1. D.R. Baghurst and D.M.P. Mingos, *J. Chem. Soc., Chem. Commun.*, 1988, 829.
2. D.R. Baghurst, A.M. Chippendale and D.M.P. Mingos, *Nature*, 1988, **332**, 311.
3. C. Wu and T. Bein, *J. Chem. Soc., Chem. Commun.*, 1996, 925.
4. D.M.P. Mingos, *Advanced Materials*, 1993, **5**, 857.

Raymond Adamson and Atif Shafiq

Cis-Platin

Felix Onasanwo and Jonathan Hussein



Cis-Platin is a chemically important anti cancer drug especially effective for the management of testicular, ovarian, head and neck tumours. Considerable evidence points towards DNA as being the main target of cis-platin in the tumour cell. Therefore attention has been placed on the difference between the adducts formed with DNA between cis- and trans- platin.

It was discovered that certain platinum containing compounds completely but reversibly inhibit cell division in the gram negative rods. Tests for anti tumour activity proved that these platinum containing compounds inhibit sarcoma 180 and and leukaemia in mice. The results showed that the compounds were effective in inhibiting the tumours and the mice remained free from tumours for up to six months living normal healthy lives, however at this stage no knowledge of the fate of the injected compounds or the mechanism of action against the tumour cells was known.

Cis-platin reaction with DNA involves the loss of two chloride ions and the formation of two Pt-N bonds to the N(7) atom of two adjacent guanosine nucleosides on the same strand. For stereochemical reasons this cannot take place with trans-platin as the formation of 1-2 inter strand crosslinks cannot take place hence the trans- isomer of platin is inactive in this field. Co-ordination of the platinum to DNA takes place in two stages, firstly the formation of the mono functional adducts primarly to the N(7) position of guanine or adenine. These react further to form bifunctional adducts at N(7) positions of nearby guanines and to a lesser extent adenines. If the co-ordinated nucleotide bases are on the same strand of DNA an inter strand crosslink is formed, however if the platinum links to two bases of opposite DNA strands the result is an inter strand adduct. The adduct formed with cis-latin is:

cis[Pt$(NH_3)_2$ [d(GpG)]

Crystals of the adduct formed have been obtained and used in an X ray crystallographic study to elucidate the molecular structure to atomic resolution.

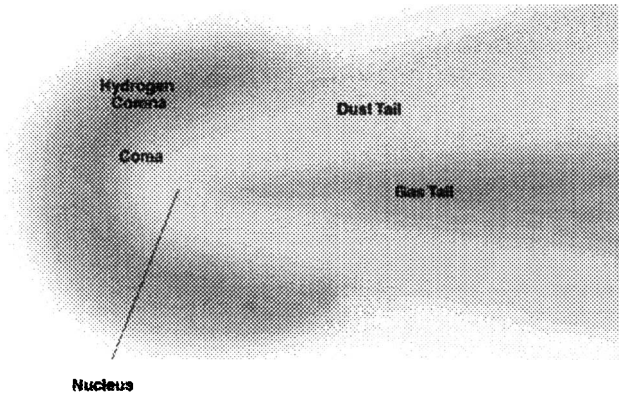
Since discovery of the antineoplastic activity of cis-platin considerable progress has been made in understanding how platinum complexes bind to DNA. Further knowledge of how anti-tumour drugs work would have major implications for further design and improvement of these drugs, it is also becoming possible to design complexes so as to bind to DNA in a predictable way paving the way for the development of new drugs for the hopeful cure of all types of cancer.

References

1. *Nature* 1969, vol **222**, pg 385.
2. *Science* 1985, vol **230**, pg 412.
3. *Progress in Inorganic Chemistry* 1990, vol **39**, pg 477.
4. *Co-ordination Chemistry Reviews* 1990, vol **100** pg 293.

Comets and the origins of life

Neil Polwart and Martin Melia

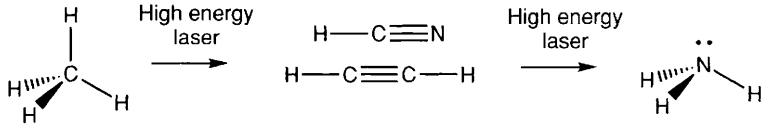


Composition of Comet 1

A comet is composed of a ball of frozen gases. The forces of a comet colliding with the Earth's surface are thought to be strong enough to cause chemical reactions that may have created the building blocks of life.

All living creatures, DNA, enzymes and proteins are built up from molecules containing the $>NH_2$ group, such groups originate from ammonia – but how the ammonia was first created has puzzled scientists for years. Scientists including a team working at NASA, have bombarded a mixture of gases (at low temp) with high energy lasers designed to simulate the forces experienced by the small molecules as they hit the Earth's surface.

Initially shocking of the gases which are rich in methane produces hydrogen cyanide and acetylene but further shocking with the lasers produces ammonia. It is possible that this ammonia eventually ended up as amino acids and became the building blocks of life. Theories along these lines have been suggested since 1961 but recent work suggests that this would not occur if there was high CO_2 concentration in the atmosphere -– as had previously been suggested. Perhaps life could exist on other planets – if the collisions with comets were repeated elsewhere.



Some interesting references:

1. Organic synthesis in Experimental Impact Shocks; *Science*, 1997, **276**, 5311, p. 390. C.P. McKay & W.J. Borucki.
2. Chemical Effects of Large Impacts on the Earth's Primitive Atmosphere; *Nature*, 1986, **319**, p. 305. B. Fegley (Jr), R.G. Prinn, H. Hartman, G.H. Watkins.
3. Probing the presently tenuous link between comets and the origins of life; *Origins of Life*, 1982, **12**, 2, p. 125. R.W. Hobbs, J.M. Hollis.
4. Comets and Life in the Universe; Advances in *Space Research*, 1994, **15**, 3, p. 81. J. Oro, T. Mills, A Zazcano.
5. Comet Impacts and Chemical Evolution of the Bombarded Earth; *Origins of Life and Evolutions of the Biosphere*, 1992, **21**, 5/6, p. 317. V.R. Oberbeck, H. Aggarwal.

Or check out the NASA home page at http://www.nasa.gov
or the Science home page at: http://www.science.com
(password needed; 18/04/97 edition).

Tutor's guide to the clues

The clues to the references should guide the students to a small number of possible references, from which the one required should be fairly obvious. Pre-1981 references must be found from *Chemical Abstracts*. References from 1981 onwards are usually most easily found using BIDS, and descriptions that successfully locate each reference are given in the Table for each topic in Appendix B.

Assessment form

Title of dictionary entry:

_____

Authors:

_____

Assessment criteria:

- Did the report start with a clear summary of the background? /10
- Was the report well written (grammar and style)? /10
- Was the science well explained? /10
- Was the presentation good (including graphics)? /10
- Was it the right length, and pitched at the right level? /10
- Were the key references correctly identified (tutor only)? /30

Total mark _____/80

Total mark as a percentage _____%

What was your overall impression of the quality of this report as % mark?

(Excellent >80%; very good 70-80%; good 60-70%; average 50-60%; poor 40-50%; very poor <40%). _____%

If appropriate, amend the marks given until the 'impression' mark awarded matches the total percentage mark.

Final mark _____%

Brief comments on good features and areas for improvement (especially where marks awarded to each of the above are either very high or very low):