WRITING A MOLECULE OF THE MONTH ARTICLE

Simon Cotton with Paul May

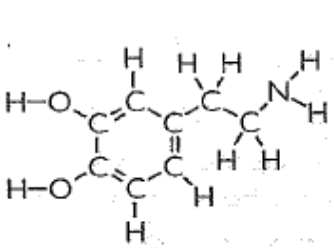
How do you write an article for the *Molecule of the Month* website? Well, perhaps you should first ask yourself ***why*** you want to write a MOTM.

Do you want to tell a story? Perhaps explain why you find a chemical particularly interesting? Maybe it is a medicine that made you better, or a substance which makes you like the smell or taste of a meal. Writing it could even help you understand a molecule; a test of your understanding something is to have to explain that topic to another person, particularly someone with a different background to yours (e.g. a non-scientist).

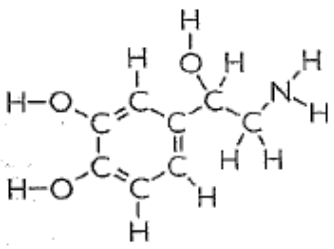
Where do you find the idea? There is a list of books at the end of this article that gives just a few of the many titles that could be consulted. What about the news? Papers and magazines will often have a story – sometimes it will identify a substance. You have got over 10 million unique molecules to pick from – thousands of new ones are made daily - and just under 300 MOTMs appear on the University of Bristol's MOTM site. There is lots of scope for you. But before you start, don't forget to check that someone else hasn't had the same idea and already written a MOTM on that substance!

For whom are you writing? This isn't a scientific paper; you are not writing for a specialist group audience. Most MOTMs are aimed at the interested 17-year-old, a pre-University student (UK A-level).

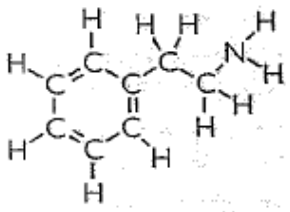
If I (Simon) tell you a bit about why I started to write MOTMs, it may help you write yours. I started writing MOTMs about 20 years ago, but some of the *processes* that I use go back a good deal further. Back in February 1992 I happened to read two articles at about the same time; one was in *Time* magazine, the other in *New Scientist*. One was on the chemistry of love, the other on the chemistry of chocolate, but both involved (β-)-phenylethylamine. That made me think about bringing that subject into the amine chemistry I was teaching Year 13 chemists, so I devised a one-sheet production in time for Valentine's Day, pointing out the structural similarity of (β-)-phenylethylamine to dopamine and norepinephrine and discussing the scientific evidence, pros and cons, for it being an aphrodisiac.



Dopamine



Norepinephrine



2-phenylethylamine (PEA)

An obvious question that I could discuss with students was whether this aromatic amine could be diazotised to make azo-dyes (Spoiler: it can't). I devised a question/answer layout

and also included a few chemical structures, which helped to break up the text. In the next few years, science items in the media were one stimulus towards other sheets (which by then I had called 'Soundbites'). A front-page news item in *The Times* about the discovery of a huge ethanol cloud in outer space led to one article discussing the other molecules that had been detected in space, whilst news items about natural organochlorine compounds led to another about the usual assumptions in the media about organic chlorine compounds being toxic. In the end these led to an article in *Education in Chemistry* and to a series of 'Soundbites' in that magazine which ran for fifteen years. So, as you write you will find new angles on a molecule.

When I started writing MOTMs in 2000, I incorporated a number of the ideas I'd used in Soundbites. Important ones include: Use the right level of English – write simple, clear prose. Try not to use technical words. Try to use a light style when you can, but a bit of dramatic understatement isn't the same as setting out to be funny. Break what you write into sections. I adopted a style based on a question-and-answer format, so you set out one thing at a time, much less daunting to a reader than an unbroken page of text. The question gives the reader an idea what is coming. It is interesting that other writers of MOTMs have tended to adopt that style.

There is a lot of scope. Back in 2008 I wrote a MOTM on a key odorant in Chanel No. 5 and naturally explained the history of the perfume– two years later someone published a whole book on the history of Chanel No. 5!

You are trying to communicate ***why*** substances are important. Molecules have a historical and social context. It could be the chemicals that fuel our living, either by making our bodies work or powering our transport. There are the medicines that heal us, or the scented molecules that make eating and drinking a rewarding experience. Then there are the molecules that are important in other animals – mammals, fish, birds and insects. Insects, in particular, use molecules called pheromones to communicate messages. Molecules are vital to the life of plants and trees.

'Chemical' is a much misused word – many in the media use it in a pejorative sense ("I don't want to eat *that*, it's full of *chemicals*!"), forgetting that chemistry drives our bodies, together with the rest of the living world. Sadly, there are people who do not understand this and have an irrational fear, known as 'chemophobia', that 'chemicals' are bad for us, while 'natural' things are good. Over 20 years ago, John Emsley wrote the book entitled *The Consumer's Good Chemical Guide* to point out how many chemicals improve the quality of our lives. You have to present the good *and* bad points of a particular molecule.

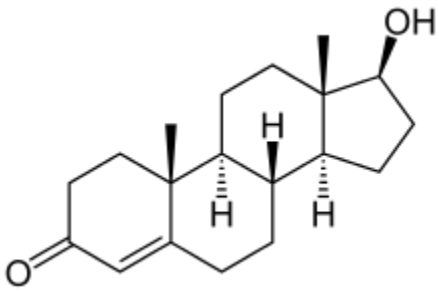
The MOTM articles are meant to be fun and interesting to read, and although they contain a lot of scientific information, the articles must not come across as too 'textbooky', otherwise readers will get bored. If you can add references to popular culture (pop stars, famous rock songs, politicians, soccer players, historical kings & queens, TV shows, well-known buildings,

etc.) it makes your chosen molecule seem relevant to ordinary people and captures their interest. It also helps greatly if you can include lots of diagrams, cartoons, pictures, etc., which break up the text. Some of these will be the structures of the molecule(s), of course, but you should try to include many non-scientific pictures (e.g. photos of relevant pop stars, buildings, places, etc). The finished piece should look more like an article in a popular magazine rather than a serious scientific journal.

Chemistry is great. Go and tell people why.

Some practicalities

1. **Chemical structures** should be drawn using a proper package, such as Chemdraw. Alternatively, line diagrams of most molecule structures are available free via Wikipedia.



Testosterone

[Photo: NEUROtiker / Public domain via Wikimedia Commons].

2. **Images**. Because the article will be copyright free (*i.e*. the Creative Commons licence), you must obtain permission from the copyright-holder of any images, diagrams, photos, *etc*, that you wish to include in your article. Photos you've taken yourself, or images you've drawn (*e.g*. molecular structures) are fine. Otherwise you must ask permission to use an image. So, you cannot just download a suitable picture from the web and use it in your page – the owner may (eventually) find out and demand compensation (which can be 100's of dollars!). So always ask permission first, and ensure that the image is correctly referenced underneath (e.g. 'Photo: by John Smith, used with permission').
   The best way to get round this copyright issue is to use 'free' images, which can be found on a number of websites. The best of these is Wikimedia Commons, which contains millions of free-to-use images on all subjects – all you need to do is ensure you correctly reference the owner of the image following the rules laid out on the WC webpage (see the example above for Testosterone).
   Line images such as chemical structures can be created as gifs, which allows them to have a transparent background. Photos and more complex diagrams should be

saved as jpg files. Try to keep the size of the images below 250 kB otherwise it may take a long time for readers to download them.

3. **References** – We try to ensure that all the articles are scientifically correct, and so they must come with references that a reader can look up if they want to fact-check what you've written. References can be scientific Journals, books, newspaper articles or web pages, so long as they are readily available in libraries or online. The formatting is up to you so long as it's consistent. Below are examples from the Dec 2019 MOTM about *modafinil*. They show a textbook, a scientific paper and a magazine article, respectively.

    - W. Dean and J. Morgenthaler, *Smart drugs & nutrients: How to improve your memory and increase your intelligence using the latest discoveries in neuroscience*. Petaluma, CA: Smart Publications, 1990.
    - A. Chatterjee, *Neurology*, 2004, **63**, 968-974, *J. Med. Ethics*, 2006, **32**, 110.
    - Margaret Talbot, Brain Gain, *The New Yorker*, April 27th 2009.

4. **Layout** – Please follow the standard layout used for MOTM articles, with the title of the molecule at the top, a one-line description of what makes the molecule noteworthy, then your name and address/affiliation. Then, for the main article, try to follow the question-and-answer style, and include regular inline images.

5. **Submission** – *before* beginning to write your article, please send an email to the MOTM website's administrator (Paul May), asking if your chosen molecule is suitable. It may be that your molecule has been done before - or is too similar to one that has been done before. Or maybe your chosen molecule is already in preparation by another author but hasn't appeared on the website yet. Or maybe it's just too boring – many molecules simply don't have an interesting 'story' surrounding them – so choose a more interesting molecule instead.
   Assuming your chosen molecule gets the go-ahead, you can then begin writing the article. You can email the finished piece as a Word document to the webpage admin, and we will check it and provide feedback and advice on how to improve it. Once it's accepted, the article will be converted into HTML for the web, and any 3D structures for the JSMol version of the article will be created. There's usually a 2-3 month wait following submission before the article goes online as that month's MOTM. All published articles will be allocated a d.o.i. number, so they count as an official refereed publication that you can add to your CV.

Some possible sources to help:

There are hundreds of chemistry and chemistry related books out there which can give you ideas about which molecules to choose or offer ideas about a style. Ultimately your style must be yours, but you can read pieces written by people like Peter Atkins, in his book 'Molecules', for example, as a way of communicating chemistry ideas to the non-specialist in

crisp and clear language. What follows is a **very** limited selection, but you should be able to find at least some of these in a library (or going cheaply second-hand).

Information on properties of chemicals

CRC Handbook of Chemistry and Physics, CRC Press, 100th edition, 2019 (The 'Rubber Handbook' – a new edition annually).

Merck *Index*, Royal Society of Chemistry, 2013, 15th edition (and previous editions).

MOTM sites

http://www.chm.bris.ac.uk/motm/motm.htm (Bristol)

http://www.3dchem.com/ (Oxford)

http://www.ch.ic.ac.uk/motm/ (Imperial)

'Interesting Molecules'

P. W. Atkins, *Molecules*, W.H.Freeman, 1987; second edition is:- P. W. Atkins, *Atkins' Molecules*, CUP, 2003. [**THE book**; it got me started. 2003 edition is OOP, and hard to find. Lots of second hand 1987 editions around]

R. Hofmann, *The Same and Not the Same*, Columbia University Press, 1995.

B. Selinger, *Chemistry in the Market Place*, Harcourt Brace, 5th edition, 1998.

J. Emsley, *Molecules at an Exhibition*, Oxford, 1998.

R. L. Myers, *The 100 Most Important Chemical Compounds: A Reference Guide***,** Greenwood Press, 2007.

P. Le Couteur and J. Burreson, *Napoleon's Buttons: How 17 Molecules Changed History*, Tarcher, 2003.

Brigitte Proust, *Petite géométrie des parfums*, Paris, Seuil, 2006. (* if you speak French)

R. J. Giguere (ed), *Molecules That Matter*, Chemical Heritage Foundation, 2008.

S. A. Cotton, *Every Molecule Tells A Story*, CRC Press, 2012.

T. Gray, *Molecules: The Elements and the Architecture of Everything*, Black Dog, 2014.

A. Brunning, *Why Does Asparagus Make Your Wee Smell?: And 57 other curious food and drink questions*, Orion, 2015.

D. Lowe, *The Chemistry Book: From Gunpowder to Graphene, 250 Milestones in the History of Chemistry*, Sterling, 2016.

Popular Chemistry

Look for anything by John Emsley and Joe Schwarcz, for example:

J. Emsley, *The Consumer's Good Chemical Guide*, W. H. Freeman, 1994.

J. Schwarcz, *Dr. Joe and What You Didn't Know: 177 Fascinating Questions & Answers about the Chemistry of Everyday Life,* ECW Press, 2004.

K. K. Karukstis and G. R. Van Hecke, *Chemistry Connections: The Chemical Basis of Everyday Phenomena*, Academic Press, 2003.

S. Q. Field, *Why There's Antifreeze in Your Toothpaste: The Chemistry of Household Ingredients*, Chicago Review Press, 2007.

S. Kean, *The Disappearing Spoon: And Other True Tales of Madness, Love, and the History of the World from the Periodic Table of the Elements*, Little Brown, 2010.

Chemistry of Food

H. McGee, *On Food and Cooking*, Harper Collins 1986; second (enlarged) edition published 2004. The biggest compendium on food chemistry and very good value for money.

T. Lister and H. Blumenthal, *Kitchen Chemistry*, RSC, 2005.

S. Q. Field, *Culinary Reactions: The Everyday Chemistry of Cooking*, Chicago Review Press, 2011.

T. Coultate, *Food: The Chemistry of its Components*, RSC, 2015 (6th ed., previous editions from 1984).

D. Eschliman and S. Ettlinger, *What's in My Food?: 75 Additives & 25 Grocery Staples Visually Explored*, Regan Arts 2015 (food additives and popular foods that contain them, both pictures and chemical structures).

M. Hartings, *Chemistry in Your Kitchen*, RSC, 2017.

Also look for books by Hervé This.

Pheromones and chemistry in living things (also "drugs from rain forests" and plants using chemistry)

W. C. Agosta, *Chemical Communication*, Scientific American Library, 1992 (pheromones).

W. C. Agosta, *Bombardier Beetles and Fever Trees*, Perseus Press, 1995.

W. C. Agosta, *Thieves, Deceivers, and Killers*, Princeton University Press, 2001.

M. J. Plotkin, *Medicine Quest*, Viking, 2000.

T. D. Wyatt, *Pheromones and Animal Behaviour: Communication by Smell and Taste,* Cambridge University Press, 2003 (2nd edition 2014).

T. Eisner, M. Eisner and M. Siegler, *Secret Weapons: Defenses of Insects, Spiders, Scorpions, and Other Many-Legged Creatures,* Belknap Press, 2007.

Plants and chemistry (linking with previous section)

J. R. Hanson, *Chemistry in the Garden*, RSC, 2007.

A. Stewart, *Wicked Plants: The A-Z of Plants That Kill, Maim, Intoxicate and Otherwise Offend*, Timber Press, 2010.

M. Séquin, *The Chemistry of Plants: Perfumes, Pigments, and Poisons*, RSC, 2012.

M. Séquin, *The Chemistry of Plants and Insects : Plants, Bugs, and Molecules*, RSC, 2017.

Medicinal Chemistry and medicinal molecules

G. L. Patrick, *An Introduction to Medicinal Chemistry*, 2nd edition, Oxford, 2001 (other editions too).

M. Wainwright, *Miracle Cure: Story of Antibiotics*, Wiley-Blackwell, 1990.

K. C. Nicolaou and T. Montagnon, *Molecules That Changed the World: A Brief History of the Art and Science of Synthesis and its Impact*, Wiley VCH, 2008.

M. C. Gerald, *The Drug Book: From Arsenic to Xanax, 250 Milestones in the History of Drugs*, Sterling, 2013.

Drugs and chemistry

J. Mann, *The Elusive Magic Bullet*, OUP, 1999; second edition is *Life Saving Drugs: the Elusive Magic Bullet*, RSC, 2004.

L. L. Iversen, *Drugs: A Very Short Introduction*, Oxford, 2001.

Drugs and Sport

S. Ungerleider, *Faust's Gold: Inside the East German Doping Machine*, Thomas Dunne Books, 2001. Updated edition 2013.

C. Cooper, *Run, Swim, Throw, Cheat: The science behind drugs in sport*, OUP, 2012.

Chemical and Biological warfare

R. Harris and J. Paxman*, A Higher Form of Killing*, Chatto and Windus, 1982 (new pbk edition, Arrow Books 2002).

A. Mayor, *Greek Fire, Poison Arrows & Scorpion Bombs*: *Biological & Chemical Warfare in the Ancient World*, Gerald Duckworth & Co, 2003 [if you also study classics, maybe extra interest]

Archaeology and Chemistry

A.M. Pollard and C. Heron, *Archaeological Chemistry*, RSC, 1996 (later edition available).

Perfumes and Smell

C. S. Sell (ed), *The Chemistry of Fragrances*, 2nd edition, RSC, 2006.

T. J. Mazzeo, *The Secret of Chanel No 5: The Biography of a Scent*, Harper Collins, 2010.

C. S. Sell, *Chemistry and The Sense of Smell*, John Wiley, 2014.

Toxicology

J. Timbrell, *The Poison Paradox: Chemicals as Friends and Foes*, Oxford University Press, 2005.

R. H. Waring, G. B. Steventon and S. C. Mitchell (eds.), *Molecules of Death*, London, Imperial College Press, 2nd edition, 2007.

Forensic chemistry

B. H. Kaye, *Science and the Detective: Selected Reading in Forensic Science*, Wiley VCH, 1995.

Why Reactions Happen

J. Keeler and P. Wothers, *Why Chemical Reactions Happen*, Oxford, 2003.

Background

S. A. Cotton, "Image Breakers: Soundbite Molecules- all you need to know about a chemical on an A4 sheet ", *Education in Chemistry*, 1996, **33**, 99-100 (Soundbites, my run up to MOTMs).

P. W. May and S. A. Cotton, *Molecules That Amaze Us*, CRC Press, 2014 (some of the MOTM articles that have been rewritten as book chapters).

P. W. May, S. A. Cotton, K. Harrison and H. S. Rzepa, “The ‘Molecule of the Month’ website – an extraordinary online chemistry educational resource for over 20 years”, *Molecules*, 2017, **22**, 549; online doi: 10.3390/molecules22040549 (three of the authors pioneered the MOTM sites in 1996).