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Top Ten ChemDraw® Tips and Tricks That Many Users Don't Know About

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Introduction

When PerkinElmer associates head out to trade shows, user group meetings, and customer sites to demonstrate ChemDraw, the company's well-known chemical drawing solution, one of the most frequent comments we hear is:

> *"I've had ChemDraw for so many years, I already know the best ways to use it."*

This paper is about the ten tips and tricks – five old favorites and five new ones – that ChemDraw fans might have missed. Mainly because there are so many tips and tricks available in ChemDraw that it is difficult to know everything. Plus as powerful, new capabilities come out with each new release, some functionality can go unnoticed. Yet, these features still manage to raise eyebrows in an audience or even get a loud "Oh that's nice!" when demonstrated.

The Top Five

After many years speaking with customers, here are the clear top five user favorites. Users say these are the ones that could have helped save a lot of time over the years had they known about them.
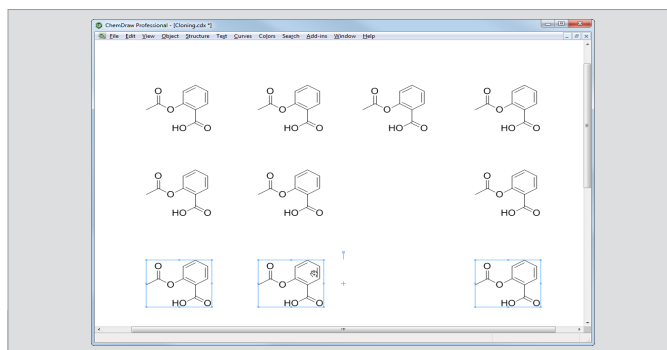
1 **Ctrl, Shift, and Clicking** *(More Windows/Mac general shortcuts)*
Often heard first when we are delivering a training: "How do you make copies of molecules?" "Please raise your hand if you are guilty of using Ctrl+c/Ctrl+v" (Cmd on Mac)." Holding the Ctrl key and clicking and dragging over any objects clones them in a far more efficient manner than the world-famous copy/ paste shortcut. What's even better is when combining Ctrl and Shift, you will create aligned copies of your molecules or reactions. This is one of the beauties of the application: plenty of functions can be readily accessed by combining resting keys (Ctrl, Shift, Alt) with the different tools used. It's all in the little things. *Time saved:* Adding your reagents to the flask
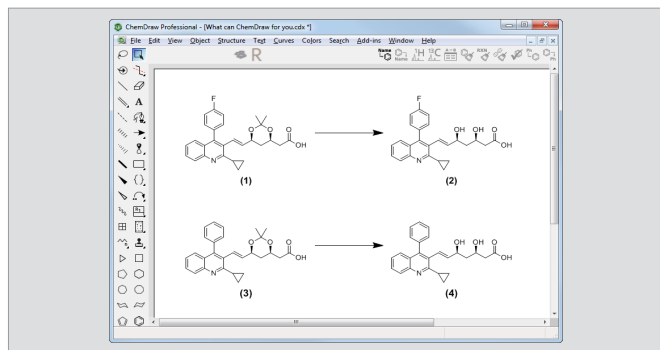
2 **Reaction Auto-numbering** *(since ChemDraw 15.1)*

"I really wish I didn't have to number all my molecules by hand." You don't! There is a Reaction Autonumbering function in ChemDraw. You can select multiple reactions in your document and go to the Structure menu > Auto number Reaction. That will add a numbering scheme underneath all the different unique structures, so you don't have to remember if you already drew it somewhere else! Naturally if you modify a structure so that it becomes unique. What's even better is that you can customize the formatting in the Document Settings > Reaction Display.

Time saved: One overnight reaction
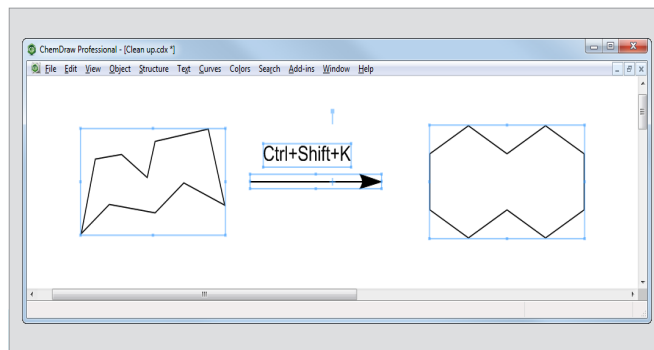
4 **Clean-up Operations** *(since ChemDraw 10 and 13)*

There are so many shortcuts available in ChemDraw that it has become difficult to create new ones because the key combinations are already taken! One users have developed that's especially impressive is structure clean-up:"Ctrl+Shift+K". Not the most straightforward to memorize, it is really useful: adjusting bond lengths and angles of a molecule neatly to have it ready for a presentation. A new one was introduced with ChemDraw 13: "Ctrl+Shift+X" to clean up entire reactions, which, combined with the quick reaction selection (double-click on reaction arrow) is always a big hit for users.

Time saved: Working-up your overnight reaction
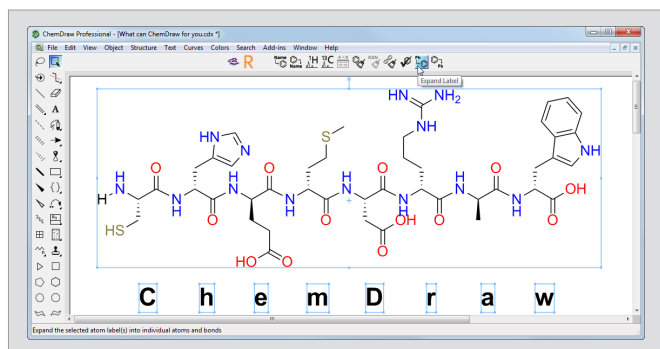
3 **Expanding and Contracting Labels** *(since ChemDraw 8)*

You have probably already used ChemDraw and used the Molecular Weight calculator. You likely have also noticed that when you type labels of common protecting groups (Cbz, Boc, TBDMS) the molecular weight gets calculated automatically and accurately. That's because ChemDraw knows to which structures labels correspond. What you may not know: you can select a label, or an entire molecule containing multiple labels and go to Structure > Expand Label or click on the corresponding icon in the Structure toolbar and POOF! a fully drawn structure magically appears! This also works to expand peptide residues from their letter representation to their full structure.

Time saved: running two or three TLCs
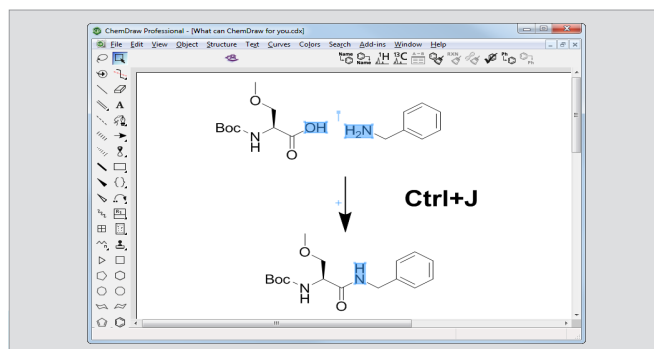
**5** **Clean-up Operations** *(since ChemDraw 8)*

We could have started this list with the joining shortcut, as it ranks very high in customer esteem, but we saved the best for last. Very simply, you select two atoms by holding down the Shift key and clicking on each of them. Then you press "Ctrl + j". "J" like "joining", and your two molecules become one. No more dragging one atom over the other and then grabbing the rest of the molecule and carrying it over to position it in a way that doesn't look too bad. You can do this with two bonds as well. One question always comes up: "What if I want the other atom to remain" for example in the case of acid plus amine gives amide. Simply press "o" to switch it to the ester. Another rule for this shortcut is: the first atom/bond you select stays put and the second will come to it.

Time saved: Packing and running a chromatography column

These are the five simple user favorites. Imagine the time you could save if you were to start using these everyday over all your documents and schemes, you could get an extra reaction run and purified. Or if you run enough reactions, why not call it a day a little bit earlier. In the end it is all in the little time-saving things, and the attention to detail, when combined together, create the best user experience there is for a chemist.

Top Five Newer Favorites

To ensure that ChemDraw continues to evolve and serve the needs of today's chemists, PerkinElmer continues to innovate it. Here are some of the most recent (user-acclaimed and/or user-requested) additions to the application.
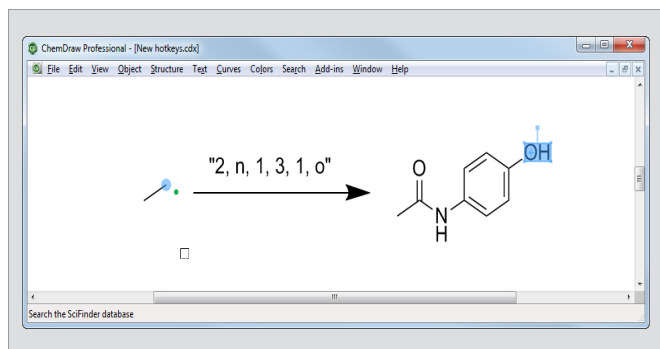
### 6 New Hotkeys, Hotspots, and Shortcuts
(ChemDraw 17.0 and 17.1)

This paragraph is about a paradigm shift in a 30-year old process. Everyone using ChemDraw likes hotkeys because they are the simplest and most efficient way to act on your molecule. Mousing over an atom or a bond (or the canvas) and pressing a designated key on your keyboard perform one designated action in that context. For example, pressing "d" over an atom switches the atom to "deuterium", while pressing "d" over a bond switches it to a dashed bond. Hotkeys are intuitive (press "o" for oxygen, "n" for nitrogen over an atom) but in ChemDraw 17 we made them even more powerful.
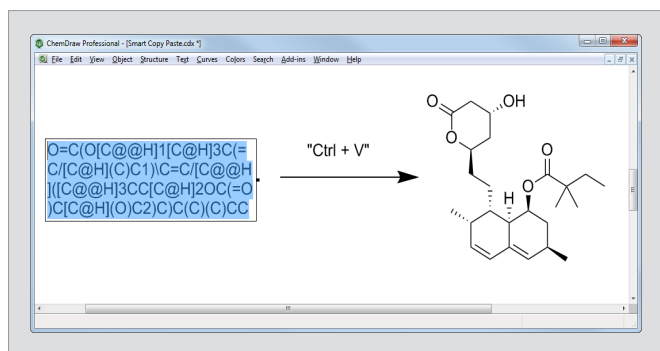
The amount of point and click tool switching involved in drawing a molecule is enormous, and yet this has been accepted as the standard way to draw a chemical structure. If you have ever used any chemistry drawing package, you can visualize how many clicks and mouse movements it takes you to draw something as trivial as a carbonyl group, which naturally prompts the question: Why, after more than 30 years

of chemistry software applications, does one need 4-5 actions to produce a carbonyl group? Also, what are the chances that after adding a carbonyl group you are going to add other functional groups to the molecule you are drawing? Imagine yourself typing an e-mail where you need to left-click after each letter to continue typing words. That is how inefficient point-and-click tools are for drawing, and to address that we needed to create an equivalent to the blinking cursor of the text editor: the hotspot. Interestingly the hotspot concept has been part of ChemDraw for some time, the caveat being that it was invisible unless you hovered over the atom or the bond. To improve that we made it visible for a couple seconds at a time as to not bother the look of molecules and reactions. Then the concept was implemented in such a way that the display would be reactivated when moving the hotspot. You move it around so easily with keyboard arrows, just like you navigate in a text document.

The next step was to create a new set of hotkeys for new functional groups with the built-in intelligence to always have a hotspot present in a designated position for the next action to take place. For example, when you produce a phenyl group from a carbon atom, and the hotspot is positioned at the 1,4-position by default after the ring is generated. Before version 17.0, the numeral keys were not producing particularly useful functions – adding "n-Bu" or "s-Bu" labels – and they were a good place to introduce new hotkey functions. Now one can directly sprout carbonyl, phenyl, cyclohexyl groups, and keep on building the molecule by simply typing it on the keyboard. Consider the following: you can now "type" an amide bond with the following sequence: "2", "n", "1". Beyond ultra-efficient drawing/typing of molecule we also added a new reaction shortcut. Extremely simple, it allows you to clone selected objects (molecule or set of molecules) and clone this selection on the other side of an arrow in one step. Holding the Ctrl (Cmd on Mac) key and pressing the keyboard arrows create a reaction in the direction of the pressed arrow, while calling this shortcut next to the edge of a page will automatically add a page to the document. Lastly, a smarter copy/paste function has recently been introduced in ChemDraw 17.1, whereby a SMILES, InChl, or HELM string will be pasted directly as a chemical structure into ChemDraw via the universal "Ctrl+V" shortcut.
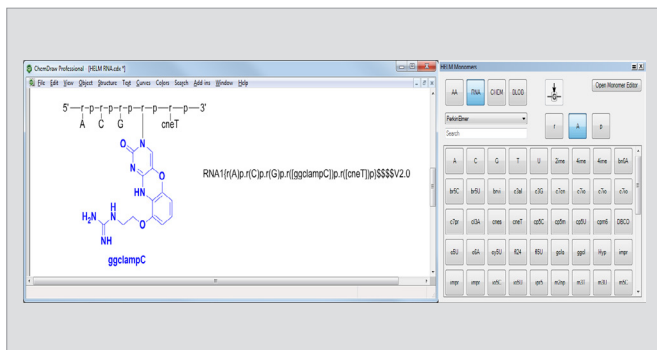
7 HELM Libraries *(ChemDraw 17.0 and 18.0)*

ChemDraw is not only about small molecules. ChemDraw 13 introduced the Biopolymer toolbar, which enabled users to depict natural peptides, nucleic acids, and paste FASTA sequences as chemically intelligible structures directly into the canvas. While useful to many, one limitation of the tool was the inability for users to custom define their own building blocks. Recognizing early on the importance of synthetic biologicals, and their growing contribution to the array of FDA-approved drugs, the Pistoia Alliance – a consortium of pharmaceutical companies and software vendors like PerkinElmer – started to work on the development the HELM notation (Hierarchical Editing Language for Macromolecules) which allows for a standardized representation of complex biomolecules. One of the specific needs was a representation flexible enough to allow for loosely defined chemical groups, such as a polymeric linker in an Antibody-Drug conjugate. In the HELM notation, each class of biomolecule has its own representation rules. As an example, a nucleic acid is described and visually depicted by a triad: the base, the ribose, and the linker. For newcomers to HELM, it is easy to compare the textual representation of HELM monomers to SMILES strings for biomolecules.
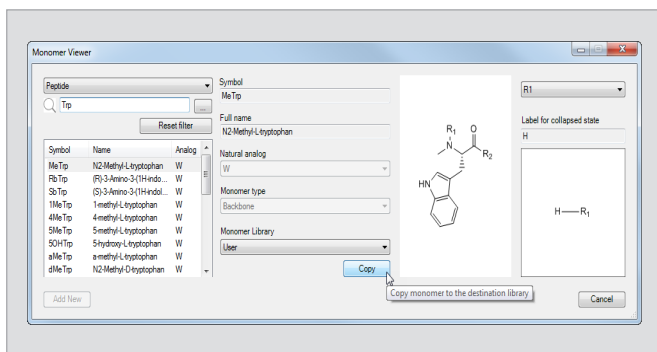
Designing a new HELM toolbar was a major step forward in ChemDraw 17.0, and the possibility to define and re-use custom, unnatural residues was a welcome addition for scientists on the more biological side of Chemistry. With ChemDraw 18.0, we took the next logical step and added a library management capability with curation and sharing functions to allow an entire organization to use the same standardized set of monomers, by letting users decide which library, and therefore which monomer definitions they want to use. To help the broader research community, PerkinElmer worked closely with Monomer.org and the Carnegie Mellon University to develop this feature and provide an application to effectively manage the various public monomer repositories.
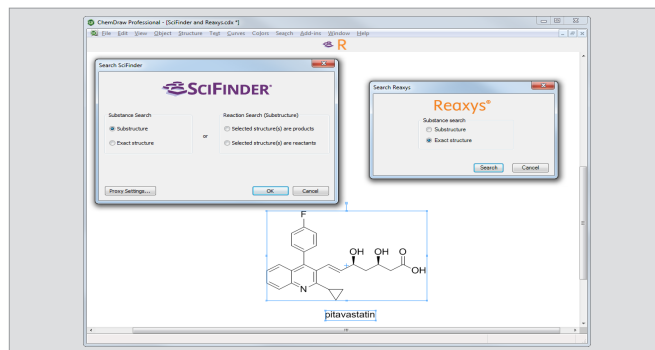
8 Partnerships and Integrations
(ChemDraw 14, 17.0 and 18.0)

Many applications, beyond ChemDraw, are used by researchers every day. Chemical or biological research each follow a cycle: you make something, you test it, and then decide what to make next. It is PerkinElmer Informatics' overarching mission to enable scientists to perform outstanding research by providing them with high quality, end-to-end software solutions that cover every aspect of the Make-Test-Decide research workflow. Before you "make things" with ChemDraw, the standard practice is to check the literature to see if someone already prepared the compound you are trying to synthesize. Two of the leading literature search engines to perform that task are SciFinder® from CAS and Reaxys® from Elsevier®. Each of these applications started with its own built-in, proprietary chemical sketcher to enable chemical structure searching, and while functional, those sketchers were perceived as less "user-friendly" than full-blown drawing applications.

Upon request from SciFinder users, PerkinElmer and CAS partnered in 2014 to introduce the first-ever integration between a chemical drawing application and a chemical literature search engine, which proved to be a major hit for ChemDraw 14 and SciFinder users alike.

Over a year ago, in the summer of 2017, we ran the ChemDraw Innovation Challenge online and asked our users which new features they would like to see brought to life in the future releases of ChemDraw. Running over the course of several months, this challenge enjoyed healthy participation from the ChemDraw community, Following a voting process, several ideas were selected as feature-worthy. One of them was an integration with Reaxys similar to the integration with SciFinder. Then PerkinElmer took the partnership with Elsevier one step further making the ChemDraw experience also available on the Reaxys website by implementing ChemDraw JS as a drawing editor for Reaxys users.

Given the importance of routine analytical chemistry in the life of a research laboratory, we also wanted to bring additional benefits to users through a renewed partnership with Mestrelab, a world-leading application for analytical data processing. Starting with version 17.0 ChemOffice Professional users get the Mestrenova ChemDraw Edition, a high-quality software application to process NMR and LC/MS, GC/MS data. A key aspect Mnova users enjoy is the ability to copy/paste ChemDraw structures onto their NMR spectra as annotations.
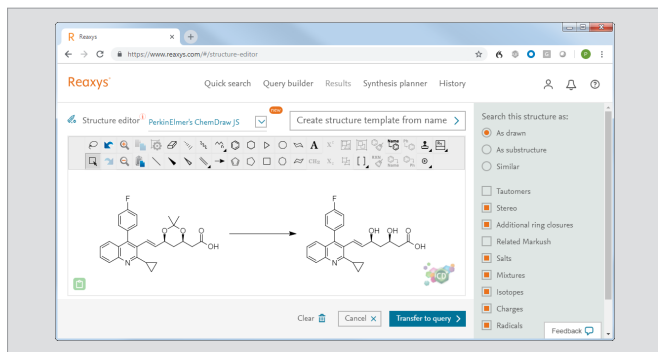
9 ChemDraw JavaScript, and ChemDraw Add-ins
(ChemDraw 17.1 and 18.0)

Going as far back as 1996, in the very early days of The World Wide Web, we recognized that allowing customers and partners to embed ChemDraw functionality into their applications would be a game changer. The first widely-adopted web browser plugin was Adobe's Acrobat Reader. The second one was ChemDraw. We also implemented ChemDraw ActiveX, which brought the same capabilities to Internet Explorer and Windows-based rich clients. This fueled an entire generation of enterprise chemistry-enabled applications including E-Notebook, Chemical Registration, and Inventory Manager.
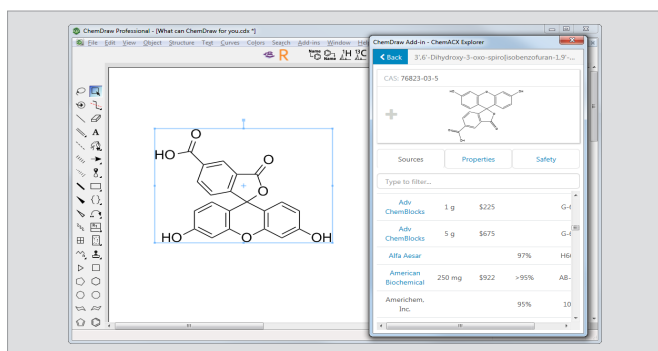

Browser plugin and ActiveX technologies, which require the user to install software packages to enhance the browser, have been steadily replaced by browser native implementations using JavaScript and HTML5. Borrowing advanced technologies from the gaming industry, the ChemDraw team was able to implement ChemDraw Direct (2015), and its successor ChemDraw JS (2017), which have brought the majority of ChemDraw functionality available in the desktop Windows and Mac versions into all modern web browsers, without the need for client software installation.

Designed to enable web applications to be "ChemDraw Smart", ChemDraw JS is a central tool used internally within the PerkinElmer Signals Ecosystem, ranging from Signals Notebook where it enables users to enter chemical reaction information, to Signals Lead Discovery where, in combination with our ChemSearch technology, it is used to query and return hits from tens of millions of chemical structures and related assay results with unprecedented performance.

From industries to academic institutions, the demand for JavaScript tools has been rising over the years, therefore PerkinElmer started offering ChemDraw JS as a development tool for our ChemOffice Professional Site License customers. Not only does ChemDraw JS provide the user experience chemists can expect from ChemDraw with matching features such as hotkeys, shortcuts, or Name-to-Structure functions, but it is also unique in its ability to copy/paste chemical structures directly into MS Office documents while retaining the underlying chemical information. This operation, made possible via a browser clipboard helper, enables a complete round-trip copy/paste operation between ChemDraw JS, ChemDraw Desktop and MS Office documents (on Windows).

We saw an opportunity to use ChemDraw to help Research IT organizations drive adoption of other applications used as part of their workflows. Namely, an early 2010 initiative led by the late Frank Brown, a renowned computational chemist, and the former head of Global Structural Chemistry at Merck, showed that user adoption of research software tools (molecular modeling, docking, registration and data analysis applications) saw a dramatic uptake by simply making them accessible from a central, preferred application such as ChemDraw. In other words, lowering the barrier to other applications by making them available from the comfort of ChemDraw, led scientists at Merck to start taking full advantage of all the tools they had at their disposal, and with it, their productivity went through the roof.

Merck was an early adopter of ChemDraw's online menu. The menu allowed savvy developers to integrate their own computational and information services making them accessible to users via the ChemDraw canvas and menu system. That technology has recently evolved into a modernized ChemDraw Add-in architecture. Developers can still add custom menu items, but it is now possible to integrate existing REST services and browser-based applications via JavaScript. We use the add-in architecture internally to integrate ChemDraw and other key PerkinElmer applications while enhancing user experiences. As an example, the first add-in we implemented was one of the Winning Ideas from the ChemDraw Innovation Challenge in 2017, and a frequent request from ChemDraw users: the ability to generate a structure from a CAS Registry Number (CAS RN). Using the CAS RN look-up add-in into ChemACX – PerkinElmer's database of >10 M commercially available substances, with > 200k CAS RNs – a user now has a way to return the structure from a given CAS RN. With version 18.0 of ChemDraw, the new ChemACX Explorer add-in now enables lightning-fast access, browsing and pasting of ChemACX data (commercial suppliers, compound properties and safety information) directly within ChemDraw.
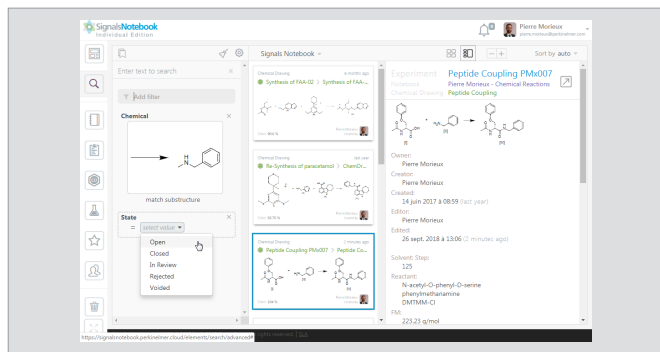
10 PerkinElmer Signals Notebook Individual Edition

With the shift towards cloud computing, PerkinElmer also wanted to offer more time-saving productivity gains with an electronic lab notebook ELN) with ChemDraw embedded. Called ChemOffice Professional, this version features a cloud-native ELN - Signals Notebook. With embedded ChemDraw to support synthetic chemistry workflows, drag and drop capture of a wide variety of electronic data files, lightning fast structure search, and a modern, highly responsive design, Signals Notebook™ is quickly becoming a preferred cloud -based ELN for discerning chemists and researchers alike. Key productivity capabilities include:

- Full Microsoft Office® and Microsoft Office® Online Integration
- Quickly add chemicals from ChemACX- database with 10 M substances
- Embedded ChemDraw
- No hardware or software to install, download, or maintain
- Highly intuitive interface that gets you up and running ASAP

Collaboration is supported with social media-like commenting and notifications and creating contextual relationships between experiments. Signals Notebook employs a modern, cloud-based micro-service architecture with advanced data lake storage technologies for document storage and indexing. PerkinElmer has architected Signals Notebook to grow with organization's needs and is horizontally scalable.

ChemOffice Professional with Signals Notebook:

- Empowers data-drive decision making
- Expedites the discovery process
- Facilitates real-time internal and external collaboration
- Retains and protect institutional knowledge
- Enables compliance to business rules and regulations
- Provides all the time saving functionality of ChemDraw

Summary

The PerkinElmer ChemDraw Team all hope these tips and tricks make ChemDraw the only chemistry drawing solution you will ever need. From drawing reactions, to processing instrument data, to structuring experimental data, ChemDraw has you covered!

For more information on ChemDraw please visit:
http://www.perkinelmer.com/product/chemdraw-professional-chemdrawpro

For a complete listing of our global offices, visit www.perkinelmer.com/ContactUs

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