

<p>Cu²⁹ Copper 63.546</p>	<p>Ga³¹ Gallium 69.723</p>	<p>Fe²⁶ Iron 55.845</p>	<p>Br³⁵ Bromine 79.904</p>	<p>V²³ Vanadium 24.305</p>	<p>C⁶ Carbon 12.011</p>	<p>S¹⁶ Sulphur 32.06</p>
<p>Ex¹³⁰ Exsikkatorium 360</p>	<p>Si¹⁴ Silicon 28.085</p>	<p>K¹⁹ Potassium 39.0983</p>	<p>K¹⁹ Potassium 39.0983</p>	<p>At⁸⁵ Astatine 210</p>	<p>O⁸ Oxygen 15.999</p>	<p>R¹²³ Rockyrraccon 300</p>
<p>Mn²⁵ Manganese 54.938</p>	<p>P¹⁵ Phosphorus 30.974</p>	<p>Ar¹⁸ Argon 39.948</p>	<p>Ti²² Titanium 47.867</p>	<p>He² Helium 4.0026</p>	<p>As³³ Arsenic 74.922</p>	<p>S¹⁶ Sulphur 32.06</p>
<p>Al¹³ Aluminum 26.982</p>	<p>Co²⁷ Cobalt 58.933</p>	<p>Ho¹² Holmium 164.93</p>	<p>Li³ Lithium 6.94</p>	<p>Cs⁵⁵ Cesium 132.91</p>	<p>De³²¹ December 2023.12</p>	<p>A²³ Avogadrum 6.02214</p>
<p>Ge³² Germanium 72.630</p>	<p>T¹¹⁹ Tagliatellium 300</p>		<p>Na¹¹ Sodium 22.990</p>	<p>Ba⁵⁶ Barium 137.33</p>	<p>Ce⁵⁸ Cerium 140.116</p>	<p>N⁷ Nitrogen 14.007</p>
<p>Ca²⁰ Calcium 40.078</p>	<p>Re⁷⁵ Rhenium 183.84</p>		<p>Ne¹⁰ Neon 20.1797</p>	<p>Be⁴ Beryllium 9.0122</p>	<p>Mb¹⁸¹ Mambojambo 2024</p>	<p>Ta⁷³ Tantalum 180.95</p>
<p>Se³⁴ Selenium 78.971</p>	<p>Cr²⁴ Chromium 51.996</p>		<p>Ni²⁸ Nickel 58.693</p>	<p>Bi⁸³ Bismuth 208.98</p>	<p>Er⁶⁸ Erbium 167.259</p>	<p>Cl¹⁷ Chlorine 35.45</p>
<p>F⁹ Fluorine 18.9984</p>	<p>Nd⁷⁵ Neodymium 144.242</p>		<p>No¹⁰² Nobelium 259</p>	<p>B⁵ Boron 10.81</p>	<p>20</p>	<p>Au⁷⁹ Gold 196.97</p>
<p>Zn³⁰ Zinc 65.38</p>	<p>H¹ Hydrogen 1.008</p>		<p>No¹⁰² Nobelium 259</p>	<p>U⁹² Uranium 238.03</p>	<p>23</p>	<p>S¹⁶ Sulphur 32.06</p>
	<p>Mg¹² Magnesium 24.305</p>	<p>H¹ Hydrogen 1.008</p>	<p>Y³⁹ Yttrium 88.906</p>	<p>Pd⁴⁶ Palladium 106.42</p>		

Exsitorial

Liebe Exsi-Leserinnen und Leser

Diese Ausgabe dreht sich um Sachen, die sich **nachhaltig** in eine Richtung entwickeln, die einem gemeinsamen Fluss folgen, die **langfristig** und **zunehmend** einer Bewegung führen. Der Trend, Exsikkator-Themen zu wählen, die aus einem weiblichen Nomen mit Endung in «nz» bestehen, wäre vielleicht nicht gebrochen worden, wenn wir stattdessen «Tendenz» gewählt hätten, aber **wo wäre dann der Spass daran?** Unabhängig davon ist diese Ausgabe so gefüllt mit bemerkenswerten Artikeln wie ein Truthahn an einem amerikanischen Feiertag. Die Trends, die in **verschiedenen Wissenschaften** bedeutungsvoll sind, sowie die **gesellschaftlichen Tendenzen der Moderne**, unterhaltende und informative Analysen werden nicht fehlen, wenn Ihr durch die folgenden Seiten blättert.

Wie es bis jetzt die Tendenz war, beginnen wir mit den naturwissenschaftlichen Artikeln, die unsere kreativen Redakteure sich ausgedacht haben. Es ist unmöglich, das Wort "Trend" zu betrachten und nicht an das **Periodensystem** zu denken. Sevim erzählt uns über die Geschichte dieser für die Chemie unerlässlichen Tabelle und die **Gesetzmässigkeiten**, die in ihr wahrnehmbar sind. Wie man die Trends der Wissenschaften, hauptsächlich Chemie, mit dem **richtigen Niveau an Abstraktion** entschlüsseln

kann, das findet Ihr in Samuels Artikel heraus. Letztendlich sind Modelle wesentlich in einem so komplexen Bereich des Wissens wie der Chemie, müssen aber richtig benutzt werden, um nichts zu viel zu vereinfachen.

Einige Trends sind positiv und sollten noch weiter bekräftigt und verbreitet werden, wie die Zunahme der **Grünen Chemie**, worüber Henrik schreibt. Aber nicht immer wollen wir Knechte von vergangene Entwicklungen und Trends sein. Leifs Artikel spricht deshalb diesmal über die **morphologische Methode von Zwicky**, die einem erlaubt, etwas aus den Grundparametern und Bedarfe hinauf zu gestalten und optimieren und alle möglichen Lösungen eines Problems zu untersuchen.

Was ist mit Trends in der Gesellschaft? Daniel analysiert die **politischen Tendenzen** der Gegenwart und die aktuelle Neigung zu Kriegen. Simon hat bemerkt, wie klassische Musik heutzutage wieder trendy wird, und hat sich dazu eine lustige **moderne Parodie** des zeitlosen "Ode an die Freude" vom modischen ChatGPT schreiben gelassen. Ausserdem erzählt er uns von seinem **Austausch in Japan**, einem Land mit einer Kultur, die gerade für Jugendliche sehr attraktiv ist. Zum Schluss testet Nonô einige trendy TikTok Rezepte mit einer **einzigartigen Zutat**.

Verzichtet auch nicht auf die Lektüre ei-

nes interessanten **Interviews mit Prof. Kuntay**, was nach vorherigen Trends des Exsikkator-Inhaltes nicht fehlen durfte. Sevim bringt uns noch den Review eines Filmes näher, um Euch zum Lachen zu bringen: «**Ferris Bueller's Day off**». Schliesslich, wie es für diese Jahreszeit geeignet ist, empfehle ich Bennets Gedicht als **Würdigung des Glühweins** und wünsche Euch allen im Namen des Exsikkator-Teams (siehe Abbildung 1.1) ein **schönes Weihnachten und einen guten**

Rutsch ins Neue Jahr!

Liebe Grüsse,

Nonô



Abbildung 1.1: Das Exsikkator-Team gönnt sich einen Glühwein.

Präsi labert

Liebe VCS-Mitglieder,
liebe Exsi-Lesende

Das Jahr sowie das Semester neigt sich langsam dem Ende zu und auch die VCS kommt langsam zur Ruhe. Nach zahlreichen Events sowie dem VCS-Jubiläum kehrt mittlerweile im HXE sowie auf dem gesamten Campus Höggerberg Ruhe ein. Ich möchte an dieser Stelle dem Vorstand sowie allen Helfenden danken, die all diese tollen Events möglich gemacht haben. Während wir mehrere wiederkehrende Events gehostet haben (Beerpong, Kastenlauf etc.) konnten wir durch den Spontaneventtopf auch andere, wie **Karaoke**, den **Retrosynthon** oder das **«Pimp-your-Labcoat»-Event** durchführen.

Im neuen Semester stehen auch schon diverse Termine an. Am **28. Februar werden wir unsere FS-GV** abhalten, natürlich wieder mit Essen und Trinken im Anschluss. In derselben Woche geht es aufs **VCS-Skiweekend** in die Lenzerheide! Während wir die Studierenden vom **Imperial College London vom 23. bis zum 25. Februar** besuchen, kommen sie im Gegenzug vom 22. bis zum 24. März nach Zürich. Auch im zweiten Jahr erfreut sich unser zweiter und neuer Austausch grosser Beliebtheit. Im Laufe des Semesters werden wieder unsere Freunde und Freundinnen aus Nijmegen zu Besuch kommen. Als neues VCS-Event wird mithilfe der NaKo ein **Flohmarkt im Rahmen der Sustainability Week**

am Höggerberg angestrebt. Mehr Infos dazu folgen aber noch...

Auch hochschulpolitisch regt sich momentan einiges! Allgegenwärtig beschäftigt uns **PAKETH** (Prüfungen und Akademischer Kalender an der ETH), wo es langsam in Detailprojekte geht, wie zum Beispiel um die Länge der Lernphase, die Art und Dauer von Repetitionen sowie Ausgleichsleistungen. In diesem Rahmen wollen wir auch viele **Vorlesungen verbessern** und sind natürlich wie immer sehr froh über Feedback – sei es zu einzelnen Lerneinheiten oder zu Gesamtspekten. Wahrscheinlich werden wir an der nächsten GV eine Arbeitsgruppe gründen, welche sich dauerhaft diesem Thema widmen wird. Weitere Infos kommen zu einem späteren Zeitpunkt.

Solltet Ihr Lust bekommen haben, euch bei einem dieser Themen oder einem anderen in der VCS einzubringen, so meldet euch gerne. Ob Ihr einen Vorstandsposten übernehmen oder nur einmal in einer Kommission helfen wollt: wir sind immer offen für eure Mitarbeit und freuen uns darauf!

Damit wars das von mir für dieses Jahr. Ich hoffe, Ihr habt alle eine erholsame Zeit mit euren Liebsten. Kommt gut ins neue Jahr!

Euer Paul



Trend

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Der Trend des Weihnachtsgetränkes

Bennet Burmeister

Wenn die Kastanien zu Schneeflocken werden,
und die Blätterberge zu Iglus.

Wenn die letzten Sommerstrahlen die Haut verfehlen,
und die Kälte der schier ewigen Dunkelheit einsetzt.

Wenn die Menschen, mehr denn je wie Bären, sich nur mürrisch noch in ihre Höhlen
zurückbegeben wollen.

Und Gespräche nur noch selten die eisige Stille durchschneiden.

Dann weiss ich, dass ich heimkehren muss.

Durch die ewigen, eisigen Tiefen des undurchdringlichen Strassenschneemorastes,
durch die hetzenden Weihnachtseinkäufer und die vielen verlockenden Werbereklamen,
durch die schimpfenden Bahnpassagiere, die rechtzeitig zu ihren Familien erreichen
wollen

Und die suchenden Mütter, die auf ihre Kinder warten.

Zu ihm, inmitten der gleissenden Lichterpracht.

Inmitten der strahlenden Kinderaugen, die in den Körpern der Erwachsenen gefangen
sind

Und doch letztendlich nur Weihnachten feiern wollen.

Zusammen, mit einem heissen Wohle, mit dieser rot-köstlichen Substanz.



Movie Review: *Ferris Bueller's Day Off*

Sevim Kahya In a time when bell-bottoms, jazz, record players, denim skirts, and men with long hair are trending, it was obvious to me that I needed to make a movie review about an oldie's movie, preferably an **iconic John Hughes** one. And I chose *Ferris Bueller's Day Off*, because it is one of my favorites for many reasons.

The movie starts with single shots of the title sequence on a black background. We hear a man talking about the weather forecast from a radio, telling us that it will be a warm and sunny day, which smoothly foreshadows some of the events that are about to take place.

We get introduced into the **mischievous and humorous world of Ferris Bueller**. After making his parents believe that he is too sick to go to school, they go off to work. When he made sure they left the house, he pulls away his blanket, stands up from his bed, and, surprisingly, he goes off to talk directly to the audience and looks straight into the camera (**fourth wall breaking**). He talks in an instructive way and gives timeless, more or less relevant, and light-hearted tips to the audience in his monologue (“[...] -isms in my opinion are not good. A person should not believe in an -ism. He should believe in himself.”¹). Among other things, we accompany him, his girlfriend Sloane, and his awkwardly insecure best friend Cameron when they **skip school** and enjoy the warm weather while going to a football game, the museum, and eating in a fancy restaurant.

It is a funny **coming-of-age movie** with extraordinary characters and **iconic quotes** (just like every other John Hughes movie). A few scenes of the movie were even remade. Like the remake of the running scene at the end of the movie for the Domino's Commercial with Joe Keery, or the fourth wall-breaking and the robe scene in *Deadpool* or even the singing and dancing of Kevin in the movie *Home Alone*.

The movie is filled with scenes that were beautifully shot in a museum (where we even get a glimpse of a few famous paintings e.g., *Nighthawks* by Edward Hopper), the crowded scene in the Chicago Mercantile Exchange, the boring school scenes, and the parade scene – oh the parade scene. That is my absolute favorite. The Beatles song “Twist and Shout” mixed with various people dancing to it and Ferris just having the time of his life while lip-syncing – that scene brings me pure joy! **Matthew Broderick** was perfect for this role, he pulled it off flawlessly.

It is a 5/5 movie in every aspect: amusing, upbeat, relatable.

I am going to end this review with THE most iconic quote of the movie (from Ferris

¹ “-ism” as in socialism, communism, anarchism...



himself) and also very relatable to the uni life:

“Life moves pretty fast. If you don’t stop and look around once in a while, you could miss it.”

Disclaimer: The author of this review does not take any responsibility for students skipping lectures and/or neglecting their studies after having watched *Ferris Bueller’s Day Off*.



Alle Wege führen zu Mendeleev – Trendsetter in der Chemie

Das 19. Jahrhundert – das goldene Zeitalter des Periodensystems

Sevim Kahya In meiner bisherigen, (noch) kurzen (Bio-)Chemie-Karriere bin ich schon etlichen Periodensystemen mit den verschiedensten Farben, Schriftarten, Darstellungen etc. begegnet. Während meiner Recherche für diesen Artikel wurde es sogar abstruser¹. Es scheint fast, als sei der Darstellung des Periodensystems keine Grenzen gesetzt. Doch sie haben alle eine Gemeinsamkeit, nämlich dass sie einer gewissen Struktur des Inhaltes, der Elemente, folgen. Sie verleihen dem Periodensystem ihre **Gesetzmässigkeit**. Wir nennen diese Gesetzmässigkeiten auch «**Trends im Periodensystem**». Bevor wir uns aber den offensichtlichen und wohlbekanntem Begriffen dieser Trends widmen, die schon jeder (VCS-)Ersti in den ersten Wochen des Studiums oft genug sieht und hört, machen wir eine Zeitreise² ins Jahr 1805 und verfolgen hautnah, wie sich das Periodensystem, wie wir es heute kennen, entwickelt hat und welche Trends sich dabei formten.

Dalton und die Äquivalenzmassen (1805)

Zusätzlich zu den schon in der Alchemie bekannten zehn Elementen (wie Kohlenstoff, Schwefel, Gold, Eisen und Blei) wurden vor allem im **18. Jahrhundert viele neue Elemente entdeckt**. Namentlich waren diese unter anderem Nickel, Mangan, Wasserstoff (1766), Stickstoff und Sauerstoff.

Mit diesem wachsenden Fundus an Elementen wuchs gegebenermassen auch das Verlangen, diese zu ordnen und zu kategorisieren. So gab es schon vor John Dalton einige Chemiker, die sich an diese Aufgabe heranwagten. Doch Dalton war der Erste,

der nicht nur eine Liste aus Elementen erstellte, sondern ihnen auch Massen zuwies.

Dalton stellte seine wohlbekannte **Atomtheorie** auf und benutzte diese als Leitfaden für seine Vorgehensweise und Experimente zum Bestimmen und Zuordnen der Massen. Er ging davon aus, dass Atome stets im Verhältnis 1 : 1 reagieren und erstellte so **Äquivalenzmassen** der Elemente in Bezug zum Wasserstoff, da Wasserstoff das leichteste Element ist. Aus diesem Grund ist z. B. die Masse von Sauerstoff in der Liste 7: Ein Gramm Wasserstoff reagierte mit circa sieben Gramm Sauerstoff.

¹ Folgende Begriffe sind es wert, gegoogelt zu werden: circular periodic table, Hinrichs spiral periodic table, modified pyramidal periodic table, Janet periodic table.

² Mit dem DeLorean DMC-12, versteht sich.

Döbereiners Triaden (1817)

ELEMENTS		
Hydrogen 1	+	Strontian 46
Azote 5	+	Barytes 68
Carbon 5	I	Iron 50
Oxygen 7	Z	Zinc 56
Phosphorus 9	C	Copper 56
Sulphur 13	L	Lead 90
Magnesia 20	S	Silver 190
Lime 24	G	Gold 190
Soda 28	P	Platina 190
Potash 42	M	Mercury 167

Johann Döbereiner bemerkte anhand von den Atommassen³ der Elemente, dass sich Dreiergruppen bilden lassen, sogenannte Triaden (engl. «triads»). Somit war er der Erste, der einen **Trend in den chemischen Elementen** bemerkte. Er merkte beispielsweise, dass der Mittelwert der Massen von Chlor (35.5) und Iod (127) 81.25, also ziemlich genau der Masse von Brom (80) entspricht. Auch bei den **physikalischen und chemischen Eigenschaften** bildete sich ein Muster. Während Chlor ein gelblich-grünes Gas und Iod ein dunkel-

violetter, fast schwarzer Feststoff ist, ist Brom eine braune Flüssigkeit. Die Dichte von Brom liegt zwischen denen von Chlor und Iod. Die Säurestärke von HBr liegt zwischen HCl und HI. Somit waren diese drei Elemente für Döbereiner eine **Triade**. Weitere Triaden waren zum Beispiel Lithium, Natrium und Kalium oder Calcium, Strontium und Barium.

De Chancourtois und die Periodizität (1862)

VIS TELLURIQUE
7 Avril 1862
CLASSEMENT NATUREL DES CORPS SIMPLES OU RADICAUX
D'APRÈS LE PRINCIPES DE
SYSTÈME DE CLASSIFICATION HÉLICOÏDALE ET NUMÉRIQUE
PAR A.E. BÉGUAYER DE CHANCOURTOIS

Émile Béguyer De Chancourtois war der Erste, der die **Periodizität der Elemente** bemerkte, also dass Elemente mit ähnlichen

³ Der Begriff «Atommasse» stimmt hier nicht ganz, aber wir vernachlässigen das in diesem Kontext. Die definitive Unterscheidung zwischen Atommasse und Äquivalenzmasse wurde erst 1858 am Karlsruher Chemiekongress getroffen.

Beeindruckend an Mendeleev ist, dass er **sehr genaue Vorhersagen** anhand der Trends machen konnte. Ein Beispiel, das oft genannt wird, ist Germanium (Ge), welches Mendeleev als Eka-Silizium «Es» bezeichnete. Er sagte nicht nur dessen etwaige Masse voraus, er ging so weit, unter anderem die Formel seines Oxids (EsO_2), die Dichte, den Aggregatzustand und Aussehen und Siedepunkt ziemlich genau vorherzusagen! Und noch unglaublicher: Mendeleev erstellte sein Periodensystem⁵ **27 Jahre, bevor man überhaupt subatomare Teilchen entdeckte** und ganze 42 Jahre, bevor Rutherford 1911 den positiv geladenen Atomkern erkannte. Das alles wäre gar nicht möglich ohne die helfende Hand der Natur und ihren Geniestreich der Trends.

1868 erstellte Lothar Meyer eine **Kurve der Atomvolumina**. Somit wurde auch den physikalischen (periodischen) Eigenschaften der Elemente Beachtung geschenkt.

1869 formulierte Mendeleev schliesslich sein **Gesetz der Periodizität**:

«Die Eigenschaften der Elemente sind eine periodische Funktion ihrer Atomgewichte.».

Trends im Periodensystem, wie wir sie heute kennen

Heute kennen und unterscheiden wir zwischen den vielen **physikalischen und chemischen Trends** im Periodensystem (PSE). Die klassischen Trends des PSE kennt wahrscheinlich jede/r, der es geschafft hat, diesen Artikel bis hierher zu lesen. Deshalb fällt auch dieser offensichtliche Teil so kurz (was nicht heisst, dass man nicht tiefer und mit besserem Verständnis in die Materie gehen könnte, indem man z. B. **Elektronenkonfigurationen und Orbitale** miteinbezieht!). Aber der Vollständigkeit halber (und weil dieses ganze Thema auch die Pracht und Gesetzmässigkeit der Bausteine der Erde und des Lebens zeigt) nehmen wir sie natürlich noch dazu.

Die physikalischen Trends sind: Atomvolumen (siehe Meyer, auch Atomradius), Ionisierungsenergie und Elektronenaffinität.

Die chemischen Trends sind: Elektronegativität, Valenz und Oxidationszahl, Säure- und Base-Charaktere der Oxide und Hydroxide (siehe Döbereiner Säurestärken-Vergleich).

Diese Trends lassen sich aber ihrerseits wieder **in andere Trends ableiten**. Anhand des Oxidationszahl-Trends bekommt man zum Beispiel auch Trends in **Frost-Diagrammen**.

⁵ Welches das Grundgerüst unseres heutigen Periodensystems bildet. Aus diesem Grund gehen wir nicht weiter auf den Verlauf der Geschichte ein, da er in Bezug zum Thema «Trend» in diesem Artikel einen unwesentlichen Beitrag hat.

Die Ionisierungsenergie zeigt einen Trend des **metallischen bzw. nichtmetallischen Charakters!**

Ein Thema, das unter ChemikerInnen regelmäßig zu Disputen führt, sind die **chemischen Trends**. Das aus dem Grund, dass sie **quantitativ nicht so gut bestimmt werden können** wie die physikalischen und man daher für die gleiche Sache gleich mehrere Werte hat. Man nehme zum Beispiel die Elektronegativität, wo man 3 (!) verschiedene Werte nach Pauling, Allred-Rochow und Mulliken für ein Element hat.

Springer nach $\text{E5} [\text{Kr}]4d^{10}5s^25p^2$

Ein etwas exotischer und mystischer Trend, mit dem viele wahrscheinlich auch gar nicht vertraut sind, ist der sogenannte Springerzug (engl. «knight's move»). Das kann man sich auch wirklich so wie Schach auf dem Periodensystem vorstellen, indem man also von einem Element ein «Feld» nach unten und zwei nach rechts geht. So landet man bei einem Element, das ähnliche Eigenschaften hat wie das auf dem ursprünglichen Feld. Er lässt sich vor allem für Metalle unten rechts im PSE anwenden, gilt aber nicht konsequent für alle. Elemente, bei denen es nachgewiesen wurde, sind Silber und Thallium, Cadmium und Blei, Zink und Zinn und Gallium und Antimon.

Cadmium und Blei sind beide giftig, wohingegen Zink und Zinn es nicht sind. GaCl_3 und SbCl_3 haben einen ähnlichen Schmelz-

punkt. Die Siedepunkte von CdCl_2 und PbCl_2 sind nahe beieinander. PbCrO_4 und CdCrO_4 sind beide hellgelb und in Wasser unlöslich.

Dieser sonderbare Trend ist, nebst dem, dass er einfach total cool ist, ein nützliches Werkzeug um Vermutungen über physikalische bzw. chemische Eigenschaften unbekannter Elemente zu machen. Das Element Flerovium ($Z = 114$) beispielsweise sollte ähnliche Eigenschaften wie die des Quecksilbers haben: ein Metall mit niedrigem Schmelzpunkt und gängiger Oxidationszahl +2.

Das gleiche lässt sich aber wahrscheinlich nicht mit anderen Elementen wie z. B. Thallium und Moscovium ($Z = 115$) machen. Flerovium befindet sich nämlich speziell in den «Inseln der Stabilität» bzw. 114 gehört zu den magischen Zahlen.

Superschwere Elemente und das Versagen der Trends

Die Voraussagen mittels der Trends gelten selbstverständlich nicht für alle 118 Elemente des Periodensystems, da sie durch Faktoren wie relativistische Effekte (Spin-Orbital-Wechselwirkungen) und den sogenannten Inseln der Stabilität erschwert werden. Im Prinzip versucht die Chemie zu rennen, bevor sie angefangen hat zu laufen. Denn seit Jahren wird vergeblich versucht, das Element Ununennium ($Z = 119$) zu

synthetisieren, jedoch macht man gleichzeitig Voraussagen über Elemente mit Ordnungszahlen bis 137.

Taucht man weiter in dieses Thema ein, wird man mit hochinteressanten Begriffen wie «superschwere Elemente» und «Supereactinoide» konfrontiert.

Den Trend weiterleben lassen

Von Dalton zu Mendeleev, von Triaden zum Springerzug, von Wasserstoff zum Flerovium. In diesem Artikel haben wir eine lange (hoffentlich nicht langwierige!) Strecke mit dem DeLorean zurückgelegt. Die Chemie hat sich uns wieder einmal von ihrer schönsten Seite gezeigt, wie sie paradoxerweise zugleich berechenbar und unberechenbar ist, wie ihre Geheimnisse nur so in des Menschen Unwissen schlummern und nur darauf warten, entdeckt zu werden.

Alles Gute kommt einmal zum Ende, so auch dieser Artikel. Denn weiter in die Materie einzutauchen, würde nicht nur den Rahmen des Artikels sprengen, sondern auch meinen Wissensstand. Aus diesem Grund lade ich dich, liebe/r Leser/in, ein, in die Bücher aus dem Quellenverzeichnis einzutauchen, wenn du dich genauso wie ich von diesem Trend hast mitreissen lassen und dein Wissensdurst noch nicht gestillt ist. Der Springerzug ist nämlich nicht der einzi-

ge exotische Trend ;).

Zudem kann ich die **Merck PSE App** wärmstens empfehlen, welche eine tolle Informationsquelle zu den einzelnen Elementen bietet und wunderbar den Verlauf der Trends mit Farben darstellt.

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Farbig gedruckte Quellen sind persönliche Empfehlungen der Autorin. Alle Bücher sind im Infozentrum verfügbar.



The Abstract Nature of Chemical Theories

How Chemical Trends Become Visible Through the Lens of Abstraction

Samuel Wechsler Chemists are no strangers to abstraction, using it as a powerful method of deciphering trends within the often unpredictable nature of chemical systems. In the chemical sciences, however, there is no simple algorithmic approach to discovering the appropriate level of abstraction, as it often requires a combination of deep insight and intuition about a system, as well as sparks of creativity. Critically, while applying just the right level of abstraction may render a chemical phenomenon clearer, neither under- nor over-abstraction will advance our understanding, raising the question of how to balance chemical abstraction.

“In constitutional formulae, the atoms are represented by letters and the bonds by lines. They describe the topology of the molecule.”

*Vladimir Prelog, Nobel Lecture,
December 12, 1975^[7]*

Abstraction is a central mechanism of scientific reasoning and thus a crucial driver of our ever-advancing understanding of the universe. This has been the case throughout the entire history of science: Whenever, brilliant minds have proposed paradigm-altering theories, describing in increasingly precise manner how the universe appears to behave, they first had to imagine **new levels of abstraction on which their theory could be built**. Einstein’s conception of space-time, serving as an abstract basis for his general theory of relativity, comes readily to mind.

While the method of abstraction may be most explicitly applied in mathematics, physics, and computer science, it plays an indispensable role in all chemical thinking. Consider for example, how a complex system such as the hydrogen atom is represented in many chemical studies: **All of the detailed knowledge we have acquired through the advances of quantum chemistry is condensed into the simple symbolic representation of the letter “H”**. Chemistry is abundant with such visual abstractions of complex systems. Building on the letter representation of the elements, chemists have developed a wide range of representations to illustrate the connectivity of molecules, the simplest of which are Lewis dot structures, skeletal representations, or the more detailed Natta projections.

But the “abstractness” of chemistry goes

beyond its pictorial representation of molecules and atoms. The vast landscape of theoretical chemistry includes formalisms, models, and fundamental chemical laws, all of which are built on chemical abstractions. Reaction mechanisms, for example, being one of the most fundamental chemical models,¹ are built on many layers of abstractions. When trying to predict how a set of molecules will react, one often only classifies their functional groups into abstract categories “nucleophilic” and “electrophilic”. Based on this, one can then fill in curly arrows to indicate the corresponding “attacks” (i.e., flows of electron density) in every elementary step of a reaction. Moreover, in the realm of physical chemistry, mathematical abstractions and differential equations in particular play a crucial role in explaining phenomena.

Given the complexity of the systems we study in chemistry, the abundance of abstract chemical notions, including visual representations, formalisms, and abstract mathematical expressions, should not be surprising. When confronted with problems of immense complexity, it lies in the natural problem-solving ability of humans to **subdivide the complexity** into simpler, more abstract pieces, as is perhaps most evident in how we utilize reaction mecha-

nisms to try to understand chemical reactions step by step.

Crucially, there always is a cost associated with abstracting chemical phenomena, namely, the **loss of information about the chemical system we are trying to understand**. While a simplified explanation may render chemistry more interpretable, these abstractions are always made at the risk of **neglecting important details**. Therefore, finding the appropriate level of abstraction is crucial in the study of chemical phenomena.^[3]

Levels of Abstraction in Chemistry

“All [abstractions] are wrong,
but some of them are useful.”

(G. E. P. Box, 1979^[1])

By analogy to George Box’ aphorism about the correctness of models, we can postulate that all levels of abstraction in chemistry are wrong. Even at the lowest levels of abstraction, some details of the chemistry that occurs in nature are considered insignificant enough to be neglected. So the right question to ask is not whether a given level of abstraction is correct, but rather how it advances our understanding of the chemistry at play. As an illustration of the extensive range of chemical abstractions, let us examine different levels of abstraction in ascending order (see Table 6.1).

¹ As was highlighted in Leif’s most recent “exercise in the *Verständnis vom Verstehen*”, see the last Exsi issue.

Level of Abstraction	Disregarded	Gained
Substance in free nature		
Substance in laboratory	Uncontrollable influences of the environment	Reproducibility
Chemically pure substance	Effect of impurities	Perfect reproducibility, quantitative measurements
Atomistic theory	Intermolecular interactions	Simple picture of chemical processes
Quantum theory	Non-quantum-mechanical (e.g., relativistic) effects	Explanation of basic chemical notions
Approximate quantum theoretical models	Several requirements of quantum mechanics	MO, VB schemes
Molecular geometry	Quantum mechanics	Applicability of Euclidean geometry to molecules
Structural formula	Details of chemical binding	Pictorial representation of molecular structure
Molecular topology	Differences between atoms	Frame for molecular physics and chemistry

Table 6.1: Levels of chemical abstractions in increasing degree. Adapted from Gutman et al., 1986.^[3]

Consider, for example, abstractions in the field of wet chemistry, which is undoubtedly among the least abstract procedures of all domains of chemical sciences. Although analytical methods typically do not allow for direct visualizations of molecules, it is the hands-on experience of practical laboratory work that brings us closest to actually **feeling the pulse of chemistry**. But even at this level, we start with simple abstractions that make chemistry more tangible. In the design of laboratory protocols, we explicitly assume “controlled labo-

ratory conditions”, and thus disregard environmental influences, which, to an ideally vanishing extent, will always be **beyond our influence**. Similar abstractions, perhaps surprisingly, are involved in the labeling of chemical containers: formally, we assume chemical purity of the materials we are working with.² In case these assumptions (i.e., abstractions) are only slightly inaccurate, they form the basis of our expectation that any measurement must be reproducible to be chemically and statistically significant. The additional assump-

² Of course, the experienced experimentalist (so I’m told) makes a habit of repeatedly checking these assumptions.

tion that we manipulate pure substances in the laboratory increases the level of reproducibility we expect, and also serves the foundation for quantitative measurements. However, blindly following these assumptions will at least result in flawed experimental designs, if not catastrophic lab accidents.^[3]

The deeper one delves into the intricacies of chemical substances, the more overwhelming the complexity of nature becomes. This complexity is particularly evident when examining the “making and breaking of chemical bonds” at a quantum scale, a level of detail at which chemical theories adopt increasingly mathematical and abstract forms. As a first-year student at ETH, my understanding of quantum mechanics still is rather crude. While an intuition for quantum mechanical phenomena, including the wave-particle duality, the uncertainty principle, and the inherently probabilistic nature of quantum objects continues to elude me, **it seems only reasonable to expect that a formal description of these phenomena must require higher degrees of mathematical abstractions.** Indeed, the first formalization of quantum mechanics involved such elaborate mathematical concepts of linear algebra that when Werner Heisenberg first

published his matrix mechanics formulation, **it was famously criticized by Einstein on the basis of being a purely algebraic and overly abstract “method”.** Notably, Einstein acknowledged the merit of quantum mechanical theory later in his life, in so far as its probabilistic predictions agreed exceedingly well with experiment.³ His philosophical standpoint on the matter (see quote below), however, remained clear, underscoring that the merit of any given abstraction in chemistry ultimately is assessed not through philosophical deliberations but by empirical validation.^[3, 6, 9]

“I, at any rate, am convinced that [God] does not throw dice.” (A. Einstein^[2])

When dealing with chemistry on a larger (though still microscopic) scale, the fine-grained quantum mechanical considerations of physical chemistry would impose an unnecessarily detailed level of abstraction. Consequently, in the realm of organic and inorganic chemistry, visual abstractions of higher degrees are often most appropriate. Climbing up the ladder of chemical abstractions, one first encounters various kinds of projections (Natta, Newmann, Fischer, Sawhorse, etc.) followed by the more abstract Lewis structures or skeletal representations of molecules. The

³ Perhaps, Schrödinger’s alternative formulation of quantum mechanics, now being written in Einstein’s native mathematical language of partial differential equations rather than linear algebra, also helped to change his mind.^[6]

former set of representations, mathematically speaking, **maps the exact spatial arrangement of elements in \mathbb{R}^3 to an approximate description of them in \mathbb{R}^2** , allowing us to assess the stereochemistry and perform conformational analysis of compounds. The latter set no longer aims to approximate the arrangement of elements in \mathbb{R}^3 but only to describe the connectedness of these elements, or in Prelog's words, the "topology of molecules".^[7]

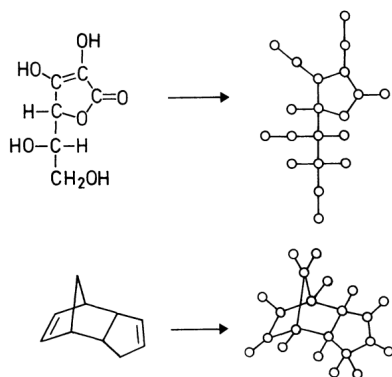


Figure 6.1: Complete molecular graphs.^[3]

The most abstract description of molecular topology even goes so far as to no longer make the distinction between atoms, but to focus purely on the connectivity of atoms: abstracting a molecule as a complete molecular graph, all parameters of physics (e.g., matter, space, energy, etc.) are disregarded. What's left is a mapping from a set of abstract elements (nodes,

representing generic atoms) to a set of unordered pairs between these elements (edges, representing bonds). One might rightly question the utility of **an abstraction that essentially ignores physics**. As is more elaborately described by Gutman et al., chemical graph theory and topology turn out to be particularly useful in the field of organic chemistry, providing a "frame" that can be filled with "molecular physics and chemistry".^[3]

Optimizing the level of abstraction – an analogy to statistical learning.

As a thought experiment, we could imagine handing over the task of interpreting organic molecular structures to an artificial intelligence. One approach could be to utilize a convolutional neural network that processes three-dimensional tensors, containing electron density mappings, as they could be obtained through scanning tunneling microscopy. In principle, an artificial intelligence should be able to extract a wide variety of molecular features, such as dipole moment, bond length, and conformational stability from this hypothetical data structure, since it has access to all relevant information on electronic states of a molecule. By incorporating an appropriate objective function and subsequent predictive algorithms, the model could theoretically develop an optimal abstract represen-

tation of a molecule, leading to maximal prediction accuracy during training.⁴

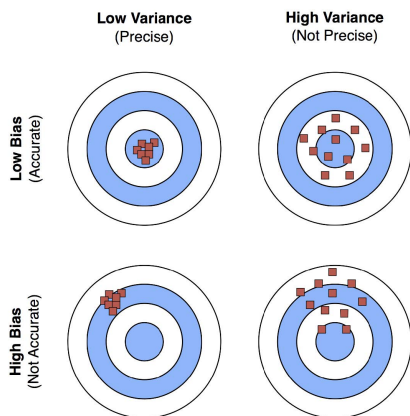


Figure 6.2: Errors resulting from bias and variance.^[8]

While the efficiency of this process might be debatable, to say the least, the notion of training a statistical model to understand the complexity of chemical structures draws up interesting **parallels between the development of chemical theories and the training of statistical models**. In training a statistical model – much like in the development of abstract chemical theories – one has to take into account the nature of training data in order to find the appropriate level of complexity (i.e., abstraction) that maximizes the accuracy of predictions. If a statistical model is overly abstract, it sim-

plifies patterns to such an extent that it fails to capture underlying trends, resulting in underfitting and high squared bias. Conversely, if a model is not abstract enough, it tends to memorize irrelevant details, leading to overfitting and excessive variance.^[5]

Crucially, it can be mathematically proven that underfitting and overfitting, resulting in high model bias or variance, respectively, are the only components playing into high test mean squared error (MSE).

$$E(y_0 - \hat{f}(x))^2 = \text{Var}(\hat{f}(x)) + [\text{Bias}(\hat{f}(x))]^2 + \text{Var}(\varepsilon)$$

Equation 6.1: Bias-Variance Tradeoff. $E(y_0 - \hat{f}(x))^2$ represents the expected MSE, and $\text{Var}(\varepsilon)$ the irreducible (aleatoric) error, which arises from the inherent randomness of any given data set. $\text{Var}(\hat{f}(x))$ and $[\text{Bias}(\hat{f}(x))]^2$ are variables for the variance and squared bias of a given estimate \hat{f} .^[4,5]

Informally, Equation 6.1 thus demonstrates that, at least in the realm of statistical learning, finding the optimal level of abstraction is what will ultimately lead us toward the model that yields **maximal predictive power**.

⁴ In the light of the notorious lack of interpretability of deep learning models, this abstract molecular representation would most likely be completely incomprehensible to us humans.

Of course, there are numerous distinctions to be made between the work of a theoretical chemist and the comparatively dull training of a statistical model. Most importantly, chemistry lacks objective functions that quantify the merit of a chemical abstraction.⁵ By extension, there are no clear-cut algorithms for tuning the hyperparameters of our theories.

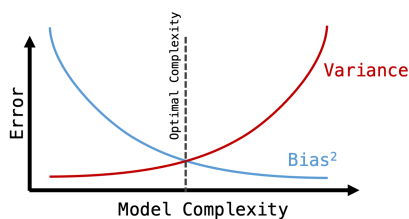


Figure 6.3: Optimal complexity resulting in minimal error.^[8]

On a larger scale however, the two processes are insightfully similar. On one hand, in analogy to avoiding overfitting, **there is a prevailing tendency in chemistry (and all of science) to favor simpler (i.e., more abstract) hypotheses and theories** over those that introduce unnecessary detail and assumptions. The reason for this preference, sometimes referred to as the principle of Occam's razor, is that simpler theories, because they rely on fewer variables and assumptions, are not only easier to interpret, but also **more likely to generalize**

well to unconsidered scenarios. On the other hand, in parallel to the risk of underfitting, **a model must also be sufficiently complex to capture the essential trends of chemistry.** By using Occam's razor to shave off just enough complexity, yet still preserving a sufficiently abstract view to filter out the noisy background of chemical phenomena, one is likely to obtain a model that provides maximal predictive power.

Conclusion

Although, the need of abstraction in chemistry may be obvious (how else could we wrap our minds around the complexity of chemical phenomena), there is no simple algorithm that can be applied in the development new abstract frameworks underlying chemical theories (unlike in statistical learning). This is essentially the challenge of chemical abstraction. Deciding which features of a system are quintessential in the examination of specific phenomena, while disregarding less relevant ones, is by no means a trivial task. It is a matter of trial and error, and at least for the most fundamental questions of chemistry, seems to require a stroke of genius.

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⁵ Note that there are also fundamental differences between human learning and statistical pattern matching.^[5]

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Trendy Japan

Trende in Japan und um Japan

Simon Hauser Hier geht es um mein Lieblingsthema, Japan. Wenn man sich mit mir unterhält, dann kommt man schnell darauf, dass meine Antworten und Assoziationen sehr oft mit «Japan dies... Japan das...» beginnen; ganz oft auch aus heiterem Himmel und ohne direkt ersichtlichen Kontext. Nun, ich geb ja zu, dass ich meine Mitmenschen schon ein bisschen oft mit diesem Thema zwangsbeglücke¹, aber in und um Japan gibts schon ein paar erwähnenswerte Trends, die ich hier nicht ungenannt lassen will.

Wirtschaftliche Trends

Zuerst ein paar Worte zur wirtschaftlichen Situation.^[1] Wenn Leute das Wort «Japan» hören, dann stellen sich die meisten eine **futuristische und fortschrittliche Metropole mit hohem Geräuschpegel und einer Fülle blinkender Lichter** vor. Woher kommt dieses Bild? Es kommt vor allem von **Japans gewaltigem Wirtschaftsboom**, der von den 1960ern bis 1973 andauerte. Japan schaffte es, innert kürzester Zeit eine der grössten Wirtschaftsmächte zu werden. Nun, während in den Köpfen der Menschen dieses Bild von Japan in einem stetigen Aufwärtstrend immer noch existiert, weht in Japan in Wirklichkeit seit dem **Platzen der Wirtschaftsblase in 1990** ein ganz anderer Wind. Viele Entwicklungen gingen dort seit diesem Zeitpunkt viel langsamer als in Europa. Viele japanische Läden bieten nicht die Möglichkeit an, mit Karte zu Zahlen. Und allgemein in Japan irgendetwas zu bezahlen, ist immer sehr umständ-

lich. Mitgliederbeiträge für Vereine, Gebühren für ein Aufenthaltsvisum oder Mieten werden dort immer noch persönlich und bar von einer Person zur anderen übergeben. Es existiert auch keine Möglichkeit, mit unserem IBAN/eBanking-System etwas direkt auf japanische Geldkonten zu überweisen. Mit den **schlechter werdenden wirtschaftlichen Bedingungen** ist auch die Geburtenrate auf einem Abwärtstrend. Dies zieht eine **älter werdende Demographie** mit sich, was mit ein Grund ist, warum in Japan bis heute noch Faxgeräte täglich verwendet werden.

Popkultur-Trends

Während diese Realität eher weniger Leuten bekannt ist, fasziniert die westliche Welt eher die **japanische Popkultur**, von der man gewisse Aspekte schon zum Mainstream zählen darf.^[2] Kurz gesagt schlagen zahlreiche **Videospiele, Anime, Manga und Light Novels** grosse Wellen. Auch vom dortigen Essen, der Mode und der Architektur

¹ ...und mache momentan das gleiche mit euch hahah

7 Trendy Japan

lässt man sich in Europa und Amerika gerne inspirieren. So manch einer, mich eingeschlossen, fühlt sich von diesem sehr fernen Land auch angezogen² und entwickelt Ambitionen, die Sprache zu lernen³ oder für kurze Ferien oder sogar einen längeren Aufenthalt dorthin zu Reisen. Bei mir manifestierte sich das ganze in einem **zweimonatigen Sprachaufenthalt** Februar–März 2023, den ich nach ungefähr sieben Jahren Japanisch-Selbststudium in Angriff nehmen konnte. Mit den nachfolgenden Fotos, die während meines Aufenthalts entstanden sind, lasse ich euch an meinen Erlebnissen Teil haben.



Abbildung 7.2: Random Schrein zwischen den Hochhäusern in Shinjuku.

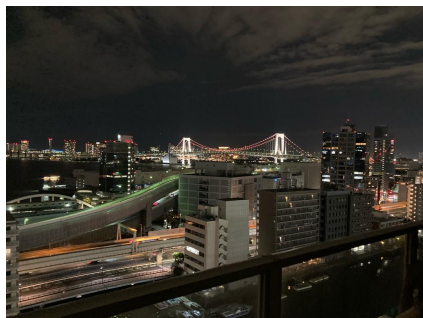


Abbildung 7.1: Nächtliche Aussicht auf Tokyo von einem Hochhaus in Minato.



Abbildung 7.3: Zusammengewürfelte Häuser an einer Strasse in Kawagoe.

² Mein grösstes Hobby neuerdings ist es, «Wolfgang Schwenkter, Geschichte Japans» zu lesen.

³ Warnung für alle, die das vor haben! Die Schrift lesen zu lernen braucht wirklich viel viiiieeeeeel Zeit. Und vom Schreiben rede ich erst gar nicht... hahahah

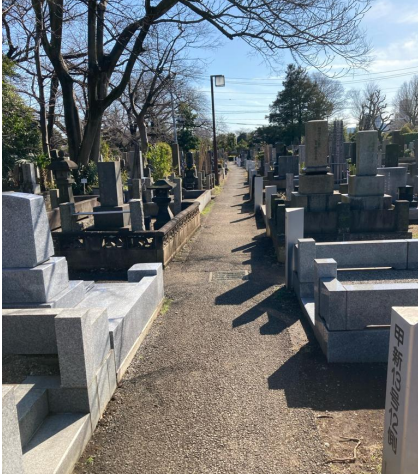


Abbildung 7.4: Eine von vielen Wegen auf dem grössten Friedhof Japans in Yanaka.

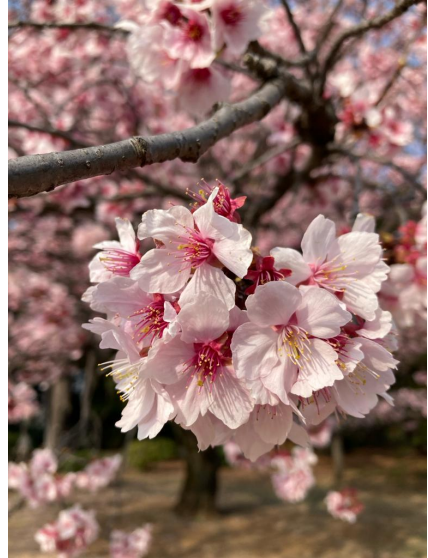


Abbildung 7.6: Sakura (Kirschblüten) erfreuen Japaner und den Rest der Welt.



Abbildung 7.5: Menschenleere, verregnete Strasse zum Senso-Tempel in Asakusa.



Abbildung 7.7: Die bekannte Chureito-Pagode in Fujiyoshida bei Regen und Nebel.

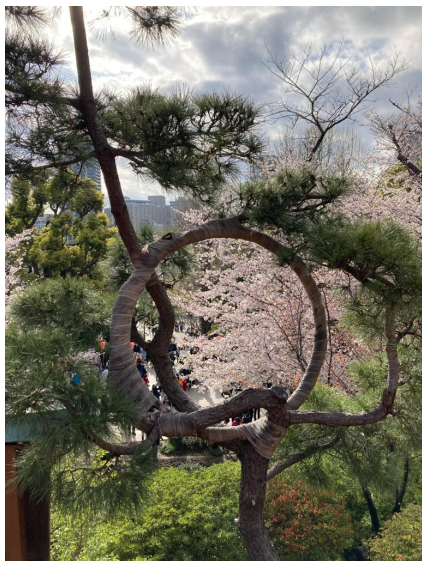


Abbildung 7.8: Kurios gewachsener Baum und Sakura im Ueno-Park.

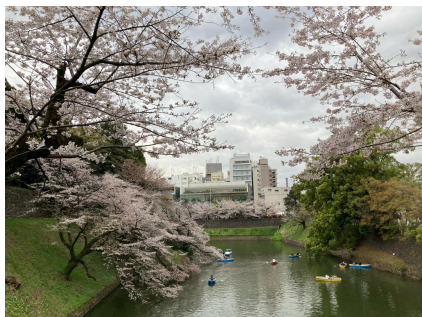


Abbildung 7.9: Sakura beim Wassergraben um den Kaiserpalast in Chiyoda.

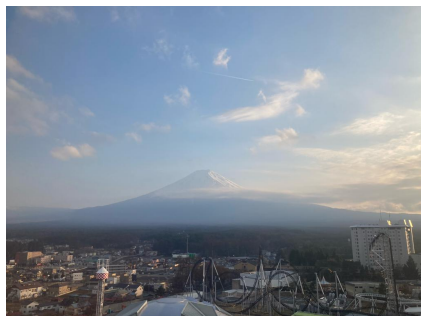


Abbildung 7.10: Sicht auf den Fuji vom Riesenrad im Fuji-Q-Highland in Fujiyoshida.



Abbildung 7.11: Brücke und ein Minishrein in einer Tempelanlage in Kawagoe.

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Pickly TikTok Trends

Nonô Saramago Of all the culinary trends one can find in TikTok, one ingredient is exceptionally frequently present: The pickled cucumber, the cornichon, the cucumber relish, or, for close friends, simply the pickle. To provide you with a representative picture of the extensive range of recipes containing pickles as the star ingredient which float through the depths of the internet, I sampled a few interesting ones for you to try. Which of these pickle recipes will pass the rigorous Betti-Basisprüfung?

Pickles in a Blanket

Reagents	Sliced cheese , like cheddar or provolone
Pickles	Oil
Materials	Non-stick pan Spatula

Method

Heat up a pan with oil and lay out a slice of cheese. Fry until it melts and the edges become crispy. Place a small pickle or a slice of a big pickle on top of the cheese and fold it around the pickle like a blanket.

Discussion

Interesting flavour combination, but must be eaten fast so the pickles don't lose their freshness from the heat of the melted cheese. Still, it's a bit more frugal than the classic burger, which would be a better use for these ingredients, with the addition of just a few more.

Conclusion

Crunchy and tangy. Passing grade, 4 out of 6.

~~Kool-Aid~~ Berry Syrup Pickle

Reagents	Pickles and pickle brine Kool-Aid or some juice concentrate substitute, flavour of choice
Materials	cup or mason jar spoon

Method

Pour the pickle juice into a separate container and mix it with Kool-Aid, or make a 50 % dilution of berry syrup and pickle brine. Pour the concoction back into the pickle jar and let it sit for a few days.

Discussion

The sweet berry syrup perfectly added complexity to the flavour of the pickles. The Kool-Aid variation or using more berry syrup might have made it more recognizable, but this is definitely something that

I would eat willingly in a dish. The added sweetness also made the used cornichons better candidates for snacking by themselves, as they got milder than normal ones.

Conclusion

An unexpected masterpiece. The “Sirup Cornichons”, a.k.a. the Swiss adaptation of Kool-Aid pickles, passed the Betti-Basisprüfung with a round 6.

The Snickle

Reagents **Snickers bar**
 big pickle

Materials Knife
 Spoon

Method

Cut the pickle in half through its length and scoop out a bit of the inside with a spoon, creating two pickle “buns”. Make a sandwich out of the pickle halves with a Snickers in between and enjoy.

Discussion

Although the hypothesis that the sweetness of the Snickers would go well with the sourness of the pickle was well justified, the flavour profile was put off balance by the nuttiness of the peanuts and the slight bitterness of the chocolate. Further experiments with more fruity sweets, or those including only caramel and white choco-

late, are recommended for a better investigation of the unusual flavour combinations with pickles. Note: my (drunk) roommate added that the Snickle gets better if, instead of eating both ingredients as a sandwich, you take a bite of each one, making it possible to fine-tune the ratio of Snickers and Pickle.



a: $t = 0$ s
The bite

b: $t = 5$ s
The wondering



c: $t = 10$ s
The realization

d: $t = 30$ s
The disgust

Figure 8.1: Time dependency of my reaction to the Snickle.

Conclusion

Very disappointing. Unfortunately, the Snickle didn't pass the Betti-Basisprüfung: 1 out of 6.

Taco Pickle

Reagents	Pickles
	Taco spice mix
Materials	Plate

Method

Put the pickles on a plate and powder the Taco spice mix on top of them. Rub the spices on the whole surface of the pickles.

Discussion

The success of this recipe largely depends on the quality of the Taco spice and the taste of the consumer. Although the spices mix well with the pickle, it is still better without them, and the Taco mix fits better with, well, Tacos. Or Guacamole.

Conclusion

Nothing out of this world. 3 out of 6.

Pickleback Shot

Reagents	Pickle brine Bourbon of Jameson Irish Whiskey
Materials	Small strainer Shot glasses Optional: small knife

Method

Strain some pickle juice inside one (shot) glass and some Whiskey into another. Drink the liquor first and the brine right after. Alternatively, carve a big pickle into a cup and fill it with the whiskey. Eat the cup after taking the shot.

Discussion

As promised by its concept, the sourness of the pickle juice neutralizes the burn of the liquor, like a pinch in the arm trying to make one forget another pain. However, firstly, it cannot compete with its Latina sister: a bit of lime after a tequila shot. Secondly, it feels illegal to try to numb the mouthfeel of a drink like whiskey, which should be tasted and relished. I do not recommend doing this with any drink better than the *Jim Bean* White Label I used.

Conclusion

Interesting experience, wouldn't make it a habit. Another pass, 4 out of 6.



Extra: Pickled Red Onions

Reagents **Spices**, like bay leaves, peppercorns, star anise and garlic

red **Onions**

apple cider vinegar and/or another **vinegar** some **sweetener**, like honey, sugar or maple syrup

Materials saucepan
mason jar
cutting knife
spoon

Method

With a good knife, slice the red onions into thin slices and pack them into a mason jar. In a small pan, heat up a mixture of vinegar (apple cider mixed with another vinegar like rice vinegar gives the best results), sweetener (here, maple syrup and raw sugar were used) and spices. If garlic is used, don't forget to remove the core. After it gets to a simmer, take off the heat and pour it into the mason jar (optionally straining it). Before closing the lid, use a spoon to push the onions into the liquid to avoid

contact with air. The relish should be ready to eat in 30 minutes, but will get tastier after a few days in the fridge.

Discussion

This indispensable quick and easy recipe for anyone who wants to pimp up a taco, burger, salad, or whatever dish you are eating for that matter. Pickled onions are as versatile and transformative as a spoon of crispy onions at the ETH mensa. In addition, the recipe can have infinite variations, using different spices, vinegars and sweeteners; and can still surprise you with a new development of flavour after a few days in the fridge. Pickled cucumbers might be a good way to revamp a dull vegetable into something tangy and exciting, yet pickled onions are the transformation of my favourite ingredient in savoury cuisine into a new explosion of flavour.

Conclusion

The perfect addition to any dish. 100 out of 6.



Wer hat Angst vor Green Chemistry?

Henrik Seng, Leif Sieben Green Chemistry ist gerade überall im Trend. Überall? Nein! Ein von unbeugsamen Chemieprofessor*innen bevölkertes Departement hört nicht auf, dem Eindringling Widerstand zu leisten. Höchste Zeit, dass sich das ändert.

Wir alle bilden uns gerne etwas darauf ein, an einer der top zehn Universitäten weltweit zu studieren. Weit abgeschlagen sind wir jedoch beim **Thema Nachhaltigkeit**. Hier belegten wir 2023 Platz 75, weit hinter etwa der TU Delft.^[5]

Wie üblich ist unser geliebtes Departement der Blinde unter den Einäugigen. Während die gesamte chemische Industrie schon längst Green Chemistry für sich entdeckt hat, hört man am D-CHAB höchstens im Master das erste Mal davon. Denn seit einem Jahr gibt es immerhin das Wahlfach «Concepts and Tools for Sustainable Chemicals Manufacture». **In keinem Chemie-Grundlagenfach oder Praktikum findet Green Chemistry bisher Platz.**

Eine schnelle Internetrecherche offenbart, dass zahlreiche Universitäten (mit denen wir uns sonst gerne auf eine Stufe stellen) dieses Konzept **bereits in die Lehre integriert** haben. Wer nach «ETH Green Chemistry» sucht, findet zwar eine ganze Reihe an Forschungsgruppen – nur leider alle am D-USYS oder D-MAVT, statt dem D-CHAB – von Informationen zu D-CHAB-Studiengängen ganz zu schweigen.

Blättert man hingegen durch die Publikationen unseres Departements, hängt jedes zweite Paper irgendwie mit diesem Thema

zusammen. Das Journal «Green Chemistry» wird sogar von einem D-CHAB-Professor herausgegeben.^[4] Stolz brüstet sich unser Department als «the Swiss heart of sustainable chemistry» auf ihrer Website.^[2] Mittlerweile erhalten fast die Hälfte aller D-CHAB-Gruppen Forschungsgelder durch NCCR Catalysis.^[3] Wieder einmal bestätigt sich, dass am D-CHAB **die Forschung der Lehre weit voraus** ist. In unserem Ersti-OC-Labor haben wir alle **literweise Lösungsmittel** verwendet, obwohl es für die meisten einfachen Reaktionen heute **grüne Alternativen basierend auf wässrigen Lösungen** gibt. In OC-Vorlesungen wird einem beigebracht, wie empfindlich organometallische Reagenzien sind, moderne Varianten von Grignard und Cross-Couplings bleiben unerwähnt.^[1]

Mit **wenig Aufwand** könnte man viele dieser Konzepte in den Grundlagenvorlesungen und Praktika der ersten Jahre vermitteln. Ähnlich wie die ETH es in den letzten Jahren geschafft hat, Informatik in allen Studiengängen zu verankern, könnte man auch **Nachhaltigkeit als grundlegendes Konzept in das Curriculum verankern**. Das Know-How ist da – einzig der Wille zur Umsetzung hat unser Department noch nicht ganz erreicht.

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How to always have good ideas

Leif Sieben Do me a favour. Think of an airplane. I am thinking of one too right now. This was essentially the task that the first aeronautic engineers were confronted with: **Imagining an airplane**. The first ever flying machine in serial production was developed by Otto Lilienthal at the end of the 19th century. The apparatus was entirely powered by an initial sprint before take-off. To Lilienthal, **flying was like walking, just in the air**. His second design iteration used a basic engine to flap the wings of his airplane like a bird. It was only when nautical engineers who had experience building ships changed fields to design airplanes that other propulsion systems were considered. This is also where we derive the term *aeronautics* from and the reason why pilots are still called “captains”. How does a shipbuilder power an airplane? Through a propeller. After all, **an airplane is just a ship without the water**.

The mode of power you were most probably thinking of, however, is the jet engine. Unlike these other types of propulsion, jet engines really were first and foremost **developed with airplanes in mind**.¹ The man behind the patent for the jet engine is himself at least as strange as his invention seemed to the people of his time.

Fritz Zwicky, born 1898 in Varna, Bulgaria to a family of Swiss cloth merchants, was one of the 20th century’s most prolific, as well as overlooked inventors, scientists and thinkers.

After moving to Switzerland, Zwicky studied **mathematics and physics** at a little-known federal institute in Zurich where he also obtained his PhD. In 1925, he became a professor at the California Institute of Technology where he would teach until his death in 1974. In Pasadena, he would start a career as a prolific astronomer being **the first person to posit the existence of dark matter** (a name he came up with himself) by applying the virial theorem. You know the virial theorem in a different form as the equipartition theorem – stating that every degree of freedom contributes $\frac{1}{2} k_B T$ to the average energy. Its astronomical equivalent is the statement that **the kinetic energy equals half of the potential energy** $E_{kin} = \frac{1}{2} U$. Zwicky made the – admittedly bold – assumption that a galaxy is simply a large ball with a radius R and mass M moving at a speed of v . The corresponding kinetic energy in all three directions and its gravitational potential energy² are easily found with simple Newtonian physics:

$$\frac{1}{2} M \cdot 3v^2 = \frac{1}{2} \Gamma \frac{M^2}{R}$$

¹ Interestingly enough, most ships today use some version of submerged jets for steering or propulsion. Apparently, proving that the inverse holds true as well: Ships are just airplanes in water.

² Vibrational degrees of freedom and NMR transitions do not really size up to an astronomical scale, so we can safely neglect all other forms of potential energy.

Reordering this equation gives the predicted mass for a known radius and speed of a galaxy. Zwicky applied his equation to the *Coma Cluster* and predicted a mass of 10^{15} times the weight of the sun. Because the mass of a galaxy is proportional to its luminosity, **Zwicky knew that the Coma Cluster was not producing enough light** to have that mass. Thus, there must have been *dark matter* slowing down the galaxy without producing light.

Zwicky was also the **first to predict and then experimentally verify the existence of neutron stars**. He organised summer schools where high school students could help him analyse thousands of space images to detect neutron stars with an approach we would call *citizen science* today. In 1957, he was the first human to accelerate an object beyond Earth's gravitational field – only twelve days after the (much more useful) Sputnik mission launched the world's first satellite. Among his many ingenious ideas and predictions are also some less practicable ones like **turning asteroids into habitable planets or colonising the moon**. In any case, Fritz Zwicky is among the most original and productive astronomers who have ever lived. Shri Kulkarni, Zwicky's successor as director at the Mount Palomar Observatory, measures the scientific excellence of astronomers in

the unit of "Zwicky's". To him, **the world seems filled with micro-Zwicky's, even a milli-Zwicky being a rare phenomenon**.^[2]

Fritz Zwicky was very likely a genius. But calling him that also does him injustice. Zwicky had unique talent and creativity, but he also had a **very stringent methodology to come up with new ideas**. A method that anyone could learn,³ and that he would spend most of his later career trying to advocate: **The Morphological Method**.

The morphological method is meant to avoid the pitfall of design we have encountered with the airplane. When tasked to draw up the propulsion system, an engineer will base their blueprint on what seems cognitively closest to them. For a nautical engineer it is the propeller, for a biologist it would be the flapping of two wings. What humans are very bad at is to **systematically sample the solution space**.

This, however, is precisely what distinguishes the tinkerer from the engineer: the **search for optimality**. During most of our evolution we humans mostly had to tinker, i.e. locally search for a good solution. When deciding on where to set up camp at night, a caravan will not first cross the entire desert to find the best camp site but will settle for an ideal solution close to where they are. They will choose the valley of

³ In 1971, he even wrote a book about it (*Jeder ein Genie*).

a sand dune for its protection from sandstorms over the peaks, **but they will not search any further**. The power of engineering (and its mathematical formalism) is to extend search space *on paper* to cover the entire space of possible solutions. The caravans of today have a map at their disposal to find the ideal camp site, not only for tonight, but for each night of the entire trip. The engineer's task is to find this **globally optimal solution**.

Zwicky used the morphological method to systematically go through all possible designs. This is how he came up with the jet engine in the midst of the Second World War. Instead of locally optimising an already existing solution such as the propeller, he clearly defined the problem (how to efficiently power an airplane) and mapped out all the relevant parameters. The parameters make up the columns of a matrix which Zwicky calls the "morphological box".

You can apply the morphological box to anything. I, for example have recently tried to **optimise my daily muesli** with its help. Step one is to define the problem and the goal clearly: how to make myself a tasty, healthy and efficient muesli every morning. The problem is that I want to **simultaneously achieve multiple things** with my breakfast. These are the parameters (or issues) we try to cover. More abstractly,

they are also the dimensions of the solution space. Some of the parameters are: Carbohydrates, Proteins, Fibres, Healthy Fats, Vitamins, Solvent (milk, yoghurt, ...), Additions (spices, sweets, etc.).

The parameters make up the columns of the morphological box. It is very important that we truly consider all relevant parameters here, which will require some prior knowledge. In this case, I had to know what a "healthy" diet consists of. Once this was done, I continued with step three, which is **listing all possible values** for each parameter. You can find the example I worked through in Figure 10.1. I tried my best to include even solutions that felt immediately wrong. As solvents I wrote down orange juice and coffee (real things people put in their muesli!), even though I could not imagine ever using them.

The last step is to now find all combinations of values, i.e. picking any allowed combination of values from the columns. A possible muesli solution could be: cornflakes, almonds, raspberry, milk. Note that some of the values appear in multiple columns (i.e. the dimensions are not independent): milk is a solvent, as well as a source of proteins. In my case, I also allowed for multiple values from each column to be included. Another solution could be: cornflakes, almonds, raspberry, milk *and* yoghurt.

You *must* go through all possible solutions

Carbo-hydrates	Proteins	Fibres	Fats	Vitamins	Solvent	Additions
<ul style="list-style-type: none"> • Cornflakes • Oats • Fruit loops • bread crumbs • Quinoa 	<ul style="list-style-type: none"> • almonds • Walnuts • milk • yoghurt • protein powder • Quinoa • cottage cheese 	<ul style="list-style-type: none"> • apples • wheat bran • Quinoa • dates 	<ul style="list-style-type: none"> • almonds • walnuts • flaxseeds • chia • pumpkin seeds • dark chocolate • avocado 	<ul style="list-style-type: none"> • apples • banana • orange juice • dried fruit • vitamin supplements • avocado • dates 	<ul style="list-style-type: none"> • water • DMSO • coffee • orange juice • milk • yoghurt • oat milk • Vodka • coconut water • kefir 	<ul style="list-style-type: none"> • Cinnamon • sugar • pepper • salt • salted caramel • [PtCl₂]₂ • protein powder • vitamin supplements • dark chocolate • dates

Figure 10.1: Be as creative and permissive as possible in admitting possible solution values. The whole point of the morphological method lies in the elimination of bias and with the courage to find novel solutions. Maybe your muesli should also be powered by jet engines?

in this step, **lest your biases guide you awry again**. Otherwise I would not have considered the combination of two solvents (milk and yoghurt), given my own bias that such a muesli would be “too complicated”. In practice you can exclude some solutions based on consistency (e.g. orange juice and milk will not work as co-solvents). In my case, I excluded solutions which do not cover all vital nutrients, i.e. which did not have at least one value in every column. Every solution will be evaluated based on the criteria defined *beforehand*: taste, time, cost. I am happy to report that tomorrow’s muesli will consist of apples, oats, corn-

flakes, milk, and yoghurt with cinnamon as the **globally optimal solution**.⁴

This approach is easily extended to any chemical reaction, where, if anything, the parameter space is typically even smaller. Just like those original aeronautical engineers, **we chemists are also heavily biased by our experience**. Who would have even considered doing Diels-Alder reactions in water before click chemistry came along? Today’s expeditions into uncharted chemical space are often through machine learning (ML) models. One such project having

⁴ Anybody in disagreement is invited to send a letter of complaint to the editor.

been recently presented this semester by a good friend of our institute, Prof. Scott Denmark.^[3] His surprising finding was that even after the first iteration of the model, his group had already found a catalyst for a specific transformation that outperformed any previously reported one. Denmark, too, is convinced that **the big advantage of ML models in chemistry is to challenge the chemist to consider truly all solutions.** Even better, if one does not have to produce all of them synthetically.^[1]

The limitations here are clear as well: defining the parameter space for a morphological box or a ML model can also introduce biases. As Denmark realised himself, when he used a ML model to optimise a thionyl catalyst, only to then discover that phosphoric acids are much better suited. It is **extraordinarily challenging to parametrise all of chemical space**, or, in other words, to make chemistry *embeddable*. A ML model can relatively quickly learn to optimise across all thionyls, but it will not by itself consider all phosphoric acids as well. This is part of the elegance of the morphological method. Even though it can never *quantify* performance like a ML model, the morphological box effectively projects a *n*-dimensional solution space down into a manageable 2D representation. My muesli was 6D in effect, but I could find possible solutions just by combining values in a 2D table that fur-

thermore forced me to consider outlandish solutions. Perhaps Denmark would have been well served with a morphological box to find all possible molecular patterns before optimising them by ML?

So do me a favour. The next time you imagine an airplane, also **think of the fact that every component you see first had to be imagined by someone, too.** Everything we see around us is a testament to the creativity and prowess of mankind. The morphological method is extraordinarily powerful in producing new ideas. Truly anyone can be creative, simply in the sense of *creating* novel solutions. Fritz Zwicky truly believed that *everyone is a genius*. During his many stays in Switzerland, he gave lectures on his method both at ETH as well as the Migros Klubschule. In one of his speeches, which is probably the most concise introduction to his work, Zwicky laments that “because of the emergency actions which we had to fight [...] against nazis, fascists, and communists, it is doubtful whether the older among us will see the day again when we can freely choose our problems”.^[4] **Zwicky always applied his morphological method for the betterment of humanity:** first to destroy the Germans in 1945, and then to send scientific journals to their war-stricken libraries. We, once again, are free to choose our field of work, and there are more than enough problems that require new solu-

tions. All you have to do is pick one.

I want to thank Lara Turnherr for being the first to point me towards Fritz Zwicky and his morphological method.

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Zeit des Krieges?

Politische Trends

Daniel Spathelf Wir schreiben das Jahr 2023 und es ist etwas passiert, was man sich vor fünf Jahren kaum zu denken gewagt hätte: Seit bald zwei Jahren tobt **der erste grosse Krieg seit langem in Europa** zwischen Russland und der Ukraine – was zuerst als Ausnahmezustand erschien, wird zunehmend normal, viele Länder erhöhen die Wehretats und rüsten auf, langsam, aber sicher kehrt langsam wieder Kriegsstimmung in der Welt ein.

Wir leben in einer Welt, welche politisch im Wandel ist von einer unipolaren Ordnung mit den USA als Ordnungsmacht, in welcher sich die meisten Staaten mit sich selbst und ihrer wirtschaftlichen Entwicklung befassen, hin zu einer Welt sich konkurrierender Blöcke machtbewusster Staaten. Auf der einen Seite steht **die alte Ordnungsmacht USA** mit den Staaten in ihrer Einflussphäre, welche nur geringe aussenpolitische Ambitionen haben, dann gibt es den sich bildenden Machtblock derer Gegner (Russland, Iran, Venezuela). Weiterhin an der Seitenlinie stehen die meisten BRICS-Staaten, welche sich weder voll auf die eine noch auf die andere Seite stellen. Doch was ist der Trend, wie sich dies weiterentwickeln wird? Es ist absehbar, dass China und Indien ihre eigenen territorialen Ambitionen in ihrer Region haben, diese werden durch die zunehmend instabilere Weltlage realistischer zu verfolgen. Ähnliches könnte man der Türkei zusammen mit ihren «Brüdern» in Turkmenistan unterstellen, welche erst dieses Jahr Berg-Karabach von Arme-

nien zurückeroberten, in Südamerika wurde Anfang Dezember von Venezuela der Anspruch auf einen Teil Guyanas bekräftigt. Während nach dem zweiten Weltkrieg weltweit die Einstellung einkehrte, dass Eroberungskriege geächtet bis undenkbar sind, wird wieder offen **Anspruch auf Territorien** erhoben und Konflikte, die beigelegt schienen oder ruhten, werden aus der Mottenkiste geholt.

Es bereitet Sorge, wenn man darüber nachdenkt, dass es vor den bisherigen beiden Weltkriegen ebenso eine etwa zehnjährige Zeit der sich aufbauenden Spannung gab, bis letzten Endes der grosse Krieg ausbrach. Beide Male kam der Kriegsausbruch für einige Akteure überraschend, da Gegner anders handelten als sie erwarteten, wodurch ihr **Machtpoker** nicht aufging und sie sich dadurch in einem Krieg wiederfanden, den sie so (noch) nicht gewollt hatten. Ebenso ist es unwahrscheinlich, dass es in der heutigen Zeit – mit Politikern, für welche das öffentliche Ansehen entscheidend ist – bei Kabinettskriegen bleiben wird, **zumal die**

Welt so dicht besiedelt ist wie nie zuvor, wodurch viele zivile Opfer zu erwarten sind. Dadurch dürfte selbst ein Krieg, welcher nur aus Machtkalkül mit begrenzten Zielen zur Verbesserung der eigenen Position oder um realpolitische Ziele zu erreichen begann, schnell in Richtung eines «Totalen Krieges» eskalieren.

Was zieht man als neutrale Schweiz für Schlüsse daraus? Ist es wirklich schlauer, wenn man sich, wie von einigen Politikern gefordert, der NATO zuwendet? Meiner Meinung nach erhöht sich für die Schweiz das Risiko, selbst in einen Konflikt hineingezogen zu werden, falls sie sich einem grossen

Block zuwendet. Das **Andocken an einen Machtblock** dürfte nur dann in ihrem Interesse sein, falls sie direkt bedroht wird und diese Bedrohung durch die Zugehörigkeit zum Machtblock verringern kann. Da aber bis auf Österreich sämtliche Nachbarn der Schweiz zum jetzigen Zeitpunkt NATO-Mitglieder sind, und diese Stand 2023 wenig Ambitionen gegen die Schweiz vorzuziehen haben, erscheint aus Sicht der Schweiz eine Zuwendung zur NATO wenig sinnvoll.



Puzzles

Samira Neff

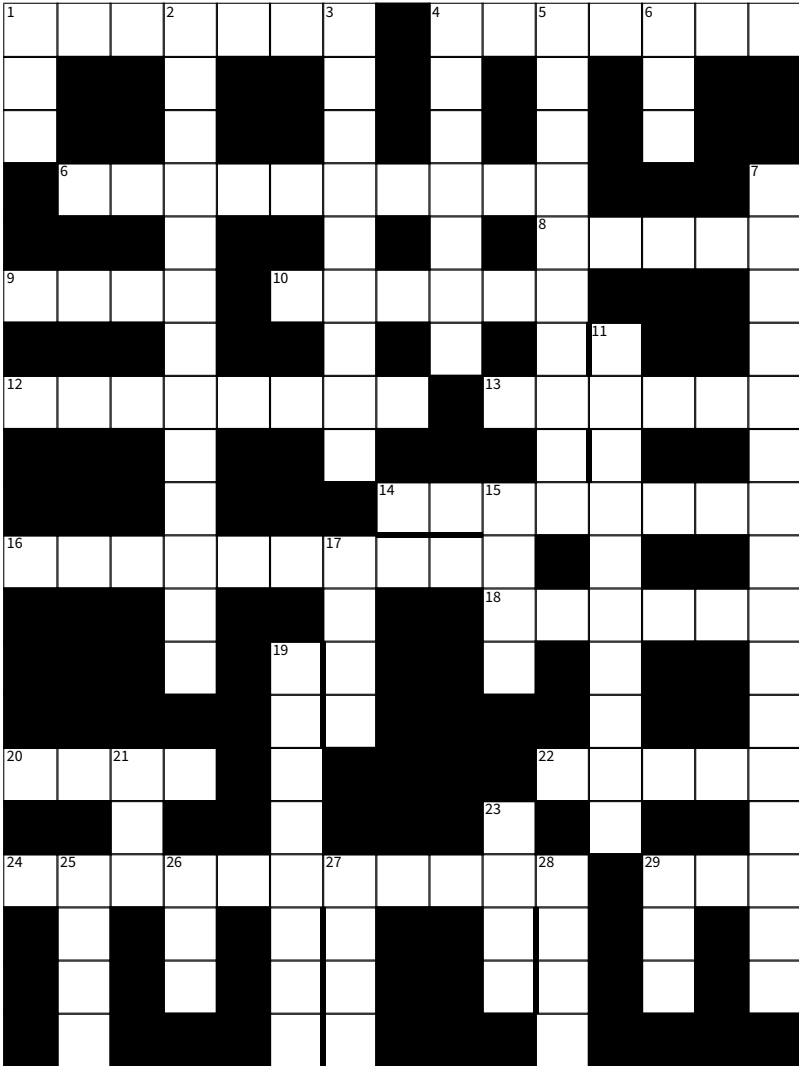
Across

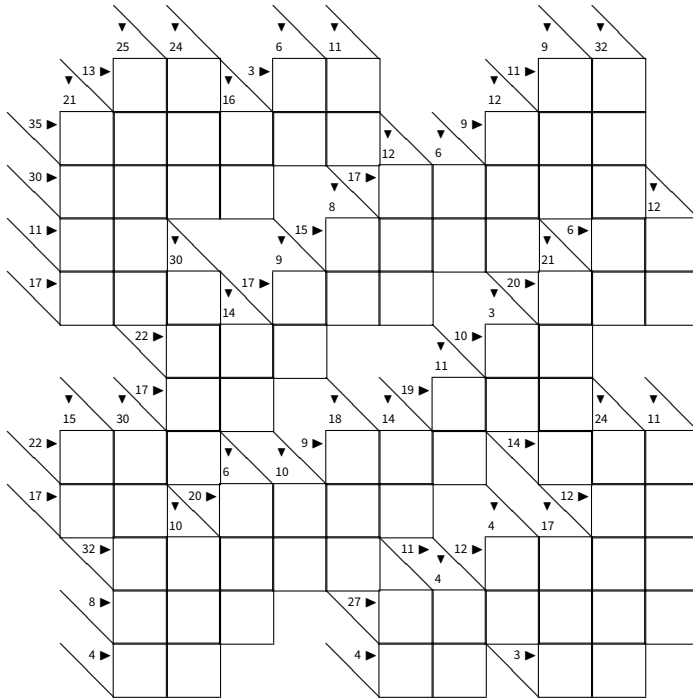
- 1 Isotope of hydrogen
- 4 Higher education after PhD
- 6 Favorite Christmas drink of the *Exsikkator* team
- 8 Compound consisting of two or more molecular rings that share only one common atom
- 9 Used in complexometric titrations
- 10 Phosphonium ____ are used in the Wittig reaction
- 12 Way of synthesizing amino acids
- 13 The effect of splitting a spectral line into several components in presence of a magnetic field
- 14 Fermion that interacts with the weak force and gravity
- 16 Used to protect things from humidity in the lab; also: what you are holding in your hands right now
- 18 Zwicky invented the jet ____
- 20 ____ magnetic ratio; γ
- 22 Alkaline; some might take this as an insult
- 24 The use of models as a form of simplifying phenomena (not only in chemistry)
- 29 Greek letter; used in statistics

Down

- 1 Lewis base and afternoon drink
- 2 “Trendy” element, discovered by Nonô herself
- 3 Formulator of the periodic law
- 4 Rows in the PTE
- 5 What practicals tend to be
- 7 Method of transforming an aldehyde or ketone to the corresponding alkane
- 11 What cristobalite and rutile have in common
- 15 First artificially synthesized organic compound
- 17 Cell culture medium
- 19 *d*-block element widely used in electronic components
- 21 The slowest step in a reaction
- 23 Name of a galaxy cluster; state of prolonged unconsciousness
- 25 If a statistical model is underfitted, it has a high squared ____
- 26 $\text{CF}_3\text{CO}_2\text{H}$
- 27 The “C” in CIP priority rules
- 28 Noble gas
- 29 Benzyloxycarbonyl

12 Puzzles





1	4		6			
						8
		3		7	9	4
	6		7		2	8
		2				5
				8		3
		9		4	7	2
	2		9			
				5		



Partytime für die Happy-Vibes!

Yo, ChatGPT droppt 'nen coolen Text, inspired by der krassen Ode an die Freude, voll am Start!

ChatGPT, Simon Hauser Ich bin voll oft im Akademischen Chor Zürich am Start. Yo, letztens konnte ich finally bei 'nem Werk mitmischen, das man easy als das «mega Klassik-Teil» bezeichnen kann. Ich mein' natürlich die 9. Symphonie von Ludwig van Beethoven. Speziell der vierte Satz, da geht der Chor ab und setzt Schillers «Ode an die Freude» musikalisch um. Das Gedicht von 1785¹ zeigt, wie Freude mega reinhaut und voll viele beeinflusst. 1808 gab's 'ne überarbeitete Version. Als Beethoven sie 1824 vertont hat, war das Gedicht echt forever und viele andere Komponisten wurden davon inspiriert. Experten meinen, dass sie durch viele Remixes sogar bis ins Lächerliche abgedreht wurde.² Aber, diese Remixes erreichen mega viele Leute, die sonst nie mit der Melodie oder dem Gedicht in Kontakt gekommen wären. Und, yo, die Melodie ist sogar die offizielle Hymne von Europa!³ Yo, Beethovens Musik ist noch immer im Game, aber die Lyrics und Worte – sind die noch im Flow? Ich will nicht sagen, ich könnt's besser oder so, aber ich hab 'ne Idee! Ich nehm' das Gedicht und lass den (trendigen) ChatGPT⁴ es in Jugendsprache übersetzen! Ich schreib jeweils 'ne Strophe Original und danach direkt den Vorschlag von ChatGPT auf. Have fun!

Strophe 1

Original

Freude, schöner Götterfunken,
Tochter aus Elisium,
Wir betreten feuertrunken,
Himmlische, dein Heiligthum.
Deine Zauber binden wieder,
Was die Mode streng getheilt,
Alle Menschen werden Brüder,
Wo dein sanfter Flügel weilt.

Trendy

Yo, checkt diesen Vibe, göttliche Energie,
Wir sind lit und im Elysium drin, easy.
Dein Platz, himmlisch und krass nice,
Dein Zauber vereint, was Trends trennen,
genau richtig.
Alle sind Homies, Brüder im Game,
Wo deine positive Energie uns umgibt, alles
ist Fame.

¹ Ungefähr 4 Jahre, bevor die French Revolution losging.

² Gib mal «Beethoven 9. Symphonie Remix» auf YouTube ein und hab 'nen Lachflash!

³ Hat aber keinen Text, weil keine Sprache favorisiert, yo!

⁴ Yo, weil AI immer on point ist und die freshesten Vorschläge bringt!

Refrain 1

Original

Seid umschlungen Millionen!
Diesen Kuss der ganzen Welt!
Brüder – überm Sternenzelt
muss ein lieber Vater wohnen.

Trendy

Alle abgeklatscht, Brudis und Schwestis!
Der Move geht global, Digga!
Bro, irgendwo da oben chillt 'n cooler Dad,
über'm Space, einfach mad.

Strophe 2

Original

Wem der grosse Wurf gelungen,
eines Freundes Freund zu seyn;
wer ein holdes Weib errungen,
mische seinen Jubel ein!
Ja – wer auch nur eine Seele
sein nennt auf dem Erdenrund!
Und wer's nie gekonnt, der stehle
weinend sich aus diesem Bund!

Trendy

Wer den krassen Move geschafft hat,
ein echter Buddy von 'nem Buddy zu sein,
wer 'ne coole Partnerin abgecheckt hat,
soll seinen Hype hier reinbringen!
Yeah – wer auch nur 'n bisschen Soul
hat auf diesem Planeten hier!
Und wer's nie gerockt hat, soll
tränen sich aus dieser Crew stehlen!

Refrain 2

Original

Was den grossen Ring bewohnt
huldige der Simpathie!
Zu den Sternen leitet sie,
Wo der Unbekannte tronet.

Trendy

Was den mega Circle bewohnt,
zeigt mad Love und Sympathie!
Die leitet uns zu den Sternen,
wo der Unbekannte abgeht.

Strophe 3

Original

Freude trinken alle Wesen
an den Brüsten der Natur,
Alle Guten, alle Bösen
folgen ihrer Rosenspur.
Küsse gab sie uns und Reben,
einen Freund, geprüft im Tod.
Wollust ward dem Wurm gegeben,
und der Cherub steht vor Gott.

Trendy

Alle chillen, haben Spass, Digga,
an der Natur, das ist der Lauf,
Gute, Böse, alle hier
folgen diesem coolen Pfad wie ein Clou.
Hugs gab sie uns und Wein,
einen Buddy, der durch dick und dünn geht.
Sogar der Wurm kriegt seinen Kick,
und der Engel chillt mit Gott ab.

Refrain 3

Original

Ihr stürzt nieder, Millionen?
Ahndest du den Schöpfer, Welt?
Such' ihn überm Sternenzelt,
über Sternen muss er wohnen.

Trendy

Alle ballern runter, Digga, was los?
Checkst du den Schöpfer, Brudi?
Such ihn weit, weit oben,
über den Sternen muss er sich tummeln.

Strophe 4

Original

Freude heisst die starke Feder
in der ewigen Natur.
Freude, Freude treibt die Räder
in der grossen Weltenuhr.
Blumen lockt sie aus den Keimen,
Sonnenschein aus dem Firmament,
Sphären rollt sie in den Räumen,
die des Sehers Rohr nicht kennt!

Trendy

Freude ist wie der Power-Boost,
in der ganzen Natur am Start.
Freude, Freude pusht den Stuff,
im grossen Welt-Game voller Art.
Sie lockt Blumen aus dem Ground,
Sonnenschein aus dem Sky,
Dreht Sphären, die so sound,
wie der Sehers Blick nie herbeizieht!

Refrain 4

Original

Froh, wie seine Sonnen fliegen,
durch des Himmels prächtgen Plan,
Laufet Brüder eure Bahn,
freudig wie ein Held zum siegen.

Trendy

Hyped, wie ihre Suns am Move sind,
durch den freshen Himmels Plan,
Go, Leute, go euren Track,
happy wie 'n Hero zum Gewinn.

Strophe 5

Original

Aus der Wahrheit Feuerspiegel
lächelt sie den Forscher an.
Zu der Tugend steilem Hügel
leitet sie des Dulders Bahn.
Auf des Glaubens Sonnenberge
sieht man ihre Fahnen wehn,
Durch den Riss gesprengter Särge
sie im Chor der Engel stehn.

Trendy

Aus der Wahrheit krasser Glow,
smiley sie den Forscher an.
Tugends Berg, so steil und proud,
guidet sie den strugglin' Man.
Glaube hoch wie'n Berg im Sky,
wo ihre Flags sich im Wind drehn,
Durch den Riss, wenn Särge fly,
sie chillt mit Engeln – Digga, nehm's hin!

Refrain 5

Original

Duldet mutig Millionen!
Duldet für die bessre Welt!
Droben überm Sternenzelt
wird ein grosser Gott belohnen.

Trendy

Stay strong, Millionen – haltet aus!
Fightet für 'ne bess're Welt!
Da oben überm Sternen-Tout
wird 'n mega Gott euch belohnen.

Strophe 6

Original

Göttern kann man nicht vergelten,
schön ists ihnen gleich zu seyn.
Gram und Armut soll sich melden
mit den Frohen sich erfreun.
Groll und Rache sei vergessen,
unserm Todfeind sei verziehn.
Keine Thräne soll ihn pressen,
keine Reue nage ihn.

Trendy

Den Göttern kann man nicht paybacken,
nice, wie sie abgehen, eh?
Sadness und broke life, sie sollen chillen
und mit den Happy Vibes connecten.
No more beef, no more hate,
dem Feind vergeben, okay?
Keine Tears sollen fliesen,
no Regrets, das ist der Play.

Refrain 6

Original

Unser Schuldbuch sei vernichtet!
ausgesöhnt die ganze Welt!
Brüder – überm Sternenzelt
richtet Gott wie wir gerichtet.

Trendy

Unsere Fehlerliste, gelöscht!
Die Welt in Harmony vereint!
Homies – über'm Space-Gewölbe,
richtet Gott, wie wir gerailed haben.

Strophe 7

Original

Freude sprudelt in Pokalen,
in der Traube goldnem Blut
trinken Sanftmut Kannibalen,
Die Verzweiflung Heldenmut –
Brüder fliegt von euren Sitzen,
wenn der volle Römer kraisst,
Lasst den Schaum zum Himmel sprützen:
Dieses Glas dem guten Geist.

Trendy

Joy, die aus Pokalen spritzt,
In Trauben, die goldenes Blut sind,
Sanftmut trinken kannibalisch,
Verzweiflung wird zu Heldenmut –
Homies, springt von euren Stühlen,
wenn der Becher voll aufdreht,
Lasst den Schaum zum Himmel fühlen:
Dieses Glas dem guten Geist geweiht.

Refrain 7

Original

Den der Sterne Wirbel loben,
den des Seraphs Hymne preist,
Dieses Glas dem guten Geist,
überm Sternenzelt dort oben!

Trendy

Den, den die Sterne feiern,
Den, den die Seraphs shouten,
Dieses Glas dem guten Geist,
über Sternen hoch dort oben!

Strophe 8

Original

Festen Mut in schwerem Leiden,
Hülfe, wo die Unschuld weint,
Ewigkeit geschwornen Eiden,
Wahrheit gegen Freund und Feind,
Männerstolz vor Königstronen, –
Brüder, gält' es Gut und Blut –
Dem Verdienste seine Kronen,
Untergang der Lügenbrut!

Trendy

Stark bleiben bei schweren Zeiten,
Helfen, wo Unschuld leidet,
Ewige Treue geschworen,
True Talk mit Freund und Feind,
Pride vor Throne und Ruhm, yo –
Homies, auch wenn's echt heftig wird –
Für Verdienste die Krone,
Bye-bye Lügen und ihr Mist!

Refrain 8

Original

Schliesst den heiligen Zirkel dichter,
schwört bei diesem goldnen Wein:
Dem Gelübde treu zu sein,
schwört es bei dem Sternenrichter!

Trendy

Formt den Squad, macht den Circle tight,
Swört bei diesem coolen Wein:
True zu sein ist das Divine,
Swört beim Sternen-Richter, alright!

***Digga, ist das nicht
voll lit?***



Prof. Kutay in Conversation

Lisa Likhacheva, Léona Dörries On a postcard-perfect snowy December afternoon, Prof. Ulrike Kutay sat down with the *Exsikkator* to speak about exciting papers, favorite thought-provoking books, and managing a research group.

Why did you decide to study biochemistry? Many people can give a short answer to this question: “Yes, I’ve always been interested in nature.” And, indeed, I am interested in nature, but still, this won’t be my short answer. I originally wanted to study something quite different: German language and literature. The final choice of biochemistry was the result of the circumstances, as I grew up in East Germany. There, interpretation of literature was politically colored, and one could not really voice an independent opinion without fearing severe consequences.

So, I discarded this option. Together with my parents, we discussed alternatives, going through the study guide of Humboldt University, looking for something with **less potential for conflicts**. Since I was also good in math and natural sciences, **biochemistry caught my attention**. After a visit at the Section of Biology at Humboldt University, I made up my mind.

But then came an unexpected turn: I applied to the university, but was rejected, for political reasons. So, I suddenly was challenged to change plans and to do something else. Luckily, I got help from my father, who was an engineer developing

chromatography systems for research. He helped me find an internship at the Institute of Nutrition at the Academy of Sciences. I started to work in a food chemistry lab, and also got the opportunity to **start a training as a lab assistant, which I really enjoyed**.

So, the decision to eventually study biochemistry was right. One year later, I applied at university again – now with support of my supervisor, and this time I got accepted. I loved my studies from the first moment, but biochemistry and cell biology certainly more than the systematics of plants and animals.

What exactly did you do in your untrained job? I was isolating proteins from fava beans. I made protein extracts and determined their isoelectric points by titration experiments. And sometimes, I also had to sort sacks of beans, like Cinderella. Still, I enjoyed the work, also since it was in a nice and supportive team.

Was that in Berlin? Close to Berlin, in Potsdam, Rehbrücke. The institute still exists,¹ but now it’s, of course, different.

When you say you were denied admission for political reasons, what are you referring to? Back when East Germany

¹ *Editor’s note:* Today: Deutsches Institut für Ernährungsforschung

existed, not everyone was allowed to study everything. There was always a political component. They made sure that people from the so-called working class got their share of places at university. Usually, not only your marks at school but also your political background would matter. In this context **it was important that your parents belonged to the communist party which my parents didn't**. And I also had a problem, because ... Well, when I was at school, we had this military training, where we needed to go to the attic of the school for shooting exercises.

For shooting exercises?! We had to shoot at paper cards with four set of rings and a drawing of a man in the middle. Your points would only count if you would also shoot the person. **I refused this**. At the end, I earned a corresponding bad statement in my school transcript, which I had to submit together with my university application. I should also say that the university refused to let me study biochemistry but did offer me to study Marxism-Leninism instead. For obvious reasons, I decided not to.

Was there anything else about growing up in East Germany that you remember fondly or that was just different from the way things work now? I think I had a really protected childhood. It felt very safe in general, and there was also a very good community spirit. I think if people live un-

der an oppressive force, they stand closer together. Of course, you had to develop a sense for whom you can trust. There was lots of solidarity among people. It wasn't possible to voice all opinions, be free in your choices, or travel without restriction, but **the support among the people and inside families was quite good**.

Fast forward many years from you sorting beans in Potsdam. You're a professor now, and one whose lectures are quite beloved. Do you yourself enjoy teaching?

I think teaching is very rewarding and it's, of course, great fun. If you get a class to listen to you, to be active, then teaching is very enjoyable. Sometimes, I also enjoy teaching in retrospect, when people sign up for block courses or semester projects in the lab, and I then hear that it was my teaching that had inspired them to do so. It is very rewarding when I think that I have managed to get them fascinated about cell biology.

And then, there is a third point that I appreciate about teaching: You learn a lot! I keep up to date in many areas of biology outside my own research through my teaching. And because I always try to prepare my lessons well, I get to read about things I perhaps wouldn't be reading much about. There is this saying, "Wer lehrt, der lernt." I don't

know who said it,² but I think that's very much true.

But I'm also always very reflective, if not to say self-critical, on my teaching. I realize that there're days when you're maybe not so much to the point and need too many words to explain something. On those days, I might not derive as much pleasure from giving the lecture as usual. **Good teaching requires lots of effort. But it all pays off** when the students get excited.

You explain extremely well! When we were thinking about whom to interview in the editorial meeting, we had a unanimous consensus: everyone wants to read Prof. Kutay's interview!

Now, turning to a completely different aspect of working in science: not the teaching, but rather being in the lab. You've also started doing this very early, even before you've officially become acquainted with biochemistry. Why did you like lab work? I think lab work really brings along exciting discoveries. You're working towards a goal. Then, at the end of the day, you look at your results. And sometimes you have these moments of discovery, and there is something wonderful and fascinating about them.

Being in the lab is also very versatile. You are doing so many different things, use so many different methods. And it's not just

biology! You need physics, you need math, you need chemistry. You need to use your brain. You have to organize. **It's one of the most versatile jobs you can think of.**

When you speak of discovery, that is, of course, wonderful. But what do you do if doing science becomes frustrating? If you enter a period where the experiments are just not working, or are working, but giving you strange results. How does one deal with that? I've never actually felt this frustration so much. And I really think if you're working in a lab, you have to be able to take joy in the small things, in taking small steps. I was always happy if my experiment was technically sound. If I had a nice gel, if I could interpret the data. And also, one shouldn't get frustrated when one doesn't get this one big result immediately; **you get there, step by step.**

Also, one should always try to be critical of one's own experiments, think why something didn't work, and try to improve. Then, one will see these improvements, and won't be frustrated. For me, whenever a project wouldn't work, I was always already thinking about the next project. But, of course, you need an environment where you have the freedom to do this.

You can also find joy in interacting with the people around you. It's also the chatting and discussing science, getting coffee to-

² *Editor's note:* Difficult to determine for sure, but the quote is often attributed to Seneca, a Roman philosopher

gether – not only the experiments – which make up your day and your life. So, I think the community also really matters. And if you're doing science, **you can always derive joy from the discoveries of others**. You open a journal you like, and you read about something that gets you excited. Going to conferences gets you excited, and you take this excitement along when you return to the lab.

You have been going to conferences, reading papers for many, many years now. Do you still get excited?

Yes, absolutely! If this feeling weren't there, then I could just leave science immediately. Our own progress is always slower than the progress of the community. I was lucky to live through a period of many revolutions in my field. First, came the discovery of all the small RNAs, and RNAi. Then, we got cryo-electron microscopy and single-particle structure reconstruction. Then, CRISPR-Cas. Now, there is artificial intelligence generating predictions of protein structures and even protein complexes.

I think biology is so rich and there's so much to learn! If you ask me about frustration, for me it's opening journals, seeing all the interesting papers, but due to time constraints not being able to keep up with reading them.

You do a lot of writing, you do a lot of reading. In your opinion, what is it that

makes a paper good? I think compelling data is actually a big part of it. But, of course, a good paper should also report an interesting finding. **The best papers are papers that report on a new discovery that is exciting for the future prospects of this field.** It's also, of course, about how the science is explained. Does it follow a logical line? Many papers are outside one's immediate area. Did the authors take an effort to write clearly? Can one understand the message and the line of thought at the first read?

Very important is also the accuracy of the data. What I really don't like at all is **overselling**. Many people will say that you have to tell a story, and I think that's true. But you should not do storytelling for the sake of storytelling. In the end, it's important that you also describe the limitations of your experimental set-up or study, and aren't just driven to come up with this nice clean narrative. Honesty in the writing is very important.

Let's continue with reading and writing, a question that might have a little less to do with science than the preceding ones. Assuming you ever have free time – which in itself is already quite a big assumption – and you're able to spend part of it reading, what is your favorite book? Answering this question fully would take very long, because I have

many, many, many favorite books. I think I collected favorite books from all ages of your life. I have favorite books from my childhood, youth, adulthood, from the childhood of my kids.

So, I can't name a favorite book. But one book that I recently read and about which I have been thinking a lot is by a German writer, Juli Zeh. It is called "Über Menschen." This book brought me back to former East Germany, and what it is today. It's set during the Corona lockdown and tells the story of a woman who leaves Berlin to settle in the rural area of Brandenburg, an area of Germany where I have often been during my childhood.

The story is about the relationship that this woman develops to her neighbor, who is a skinhead neo-Nazi. It describes how this woman establishes first a neighborly – and then a more and more friendly – relation with this person you think you would never even talk to. Thereby, the author confronts the readers with their own standpoints.

The book also provides some insights in what is behind the political landscape of current East Germany, something I am often asked about. **It tries to take (if not to say seduce) the reader away from its own black-and-white, right-or-wrong view.** It is stimulating reading with some unexpected turns, which I will not tell you in case you wish to read it.

You mentioned also having favorite books from the time when your kids were young. So, I now need to ask the inevitable question everyone wants to know the answer to. How do you combine having young kids – and worrying and thinking about those young kids, even if you're physically in the lab – with being able to do science on a very high level and lead a research group? If you ask me for a recipe that is true for everyone, I don't know it. Personal circumstances are, obviously, different among women and families. But I think **what is essential is that you are yourself dedicated to both – to your scientific passion and to your family.** And if this is your choice, then you will live for it.

Of course, how well it works depends very much on your environment and the support you get. My husband has always supported me a lot, for both the science, and the family and the kids. And he has often taken over when I was traveling. I often wondered how he was able to cope with the kids and his job when I was away. We have always functioned as a team.

You do not only need a good team in the lab, you also need a good team at home. And you also need a professional environment that understands the challenges. As a mother or father with family, you can't have meetings at all times of the day. You have

a rhythm in a family, and you need to liberate time for your family. You want to liberate time. This understanding in the professional environment has increased over the years.

Decades ago, there used to be a great support from wider family, and families were living much closer together. Now that we all are so mobile and move for our jobs through the world, this is less so. Therefore, you need much more support by other means. I think affordable³ childcare is really important. Without childcare, it's impossible.

Going back to this notion of having a good team at home, and then also a good team at work, what is your philosophy?

I'm one of the very lucky people who are in this happy, magical, productive, friendly and fun working atmosphere of the Kutay lab that so many other research groups just don't have – I cannot judge this, to be honest.

So, the question is, what is your philosophy? What is the magic? How does this work?

I really rely on the self-motivation of people. I select people for my team who seem to have the self-motivation and dedication, and who also have a character that fits into our team. I'm also looking for people who will care about how their neighbor in the lab is doing and will be ready to give

a hand. I think **when you build a team, you have to make sure that people match**. For a bigger group, where you can't supervise every pipetting step, if the people are not self-motivated or don't have a certain degree of social competence, it will be very hard.

But then, of course, I also have a role in making things run smoothly. It's my responsibility to do my very best to ensure that people have exciting projects, for which they can be self-motivated. I have a responsibility for getting these projects to fruition. I must be there to troubleshoot, to offer solutions, or alternative projects. I also must ensure that there are no conflicts in the team – among the team members or with me. Of course, when people work together, there are always some misunderstandings and conflicts can arise, but you have to be able to talk about it or to mediate, and then it usually works.

It is also very important to let your coworkers feel that you respect their opinions and of course, respect them as a person. And **you always have to remain very critical towards your own ideas and be able to say in front of your group, "Oh, I'm wrong."** No one can know everything, and no one is free of mistakes. And when we are stressed, we all make mistakes.

That's beautifully put. When you're

³ *Editor's note: institutional, e.g. daycare*

thinking about projects – or solutions to problems – is there such a thing as inspiration in science, in your opinion?

What is inspiration? It sounds as if this is something magical, but I don't believe in magic. I think if it is an emerging new idea that you then call inspiration, it has been triggered. Whenever you get new information, you always digest it. You compare it to the facts you know, you make connections, and if something doesn't fit your own thinking model, then you start wondering whether the information or your thinking model is wrong. So, it is this integration of new facts into your knowledge base that brings about novel thoughts.

So, inspiration, if you wish to call it that, is just brain activity that you engage in by being open-minded and by accommodating – adding, collecting, revising, and deleting – data in your thinking models. Therefore, **I don't think that inspiration is spontaneous**; you are just bringing together the facts.

One more question about knowledge: everyone very much admires your ability to have very specific and precise knowledge on very many different aspects of seemingly very distant things. Do you organize that information in some specific way in your mind? Or are you just lucky to have a good memory? No, I think it's just curiosity. You only memorize facts that

you are interested in, and you forget things that aren't interesting to you. I think what I know reflects what I'm interested in. I have the impression that I'm forgetting too many things. I'm not different in this respect from anyone else.

I also find myself needing to look certain things up repeatedly and wondering why I still can't recall them. But I take a very broad interest in my science, and the science around me, in other fields. Through my function as a presidential delegate at ETH I also get an opportunity to participate in many search committees. So, I listen to the science from other departments, and I learn a lot about other areas.

It's all curiosity. **Curiosity drives a knowledge base.** You might have experienced that yourself in lectures: for those classes that you thought were really in your interest area, you might remember the content much better than for other lectures.

Absolutely. And then you just don't need to study because you already know it!

Yes, exactly!

If you were talking to the twenty-year-old version of yourself, what is the primary piece of advice that you would be able to give now and that you maybe did not yet have the life experience to give to yourself back when you were in your twenties? I think this is a very interesting question. First, I would say that you

should always trust your own abilities, your strengths, and trust that you can really realize your dreams of what you want to accomplish in life. Be self-confident. That is one very important thing. Then, I also think it's crucial to always remain open-minded and flexible. Especially when you grow older, you are more inclined to form firm opinions rather than remaining open for other views.

What else? Looking back, there are always things that you haven't done so well, and you could have done better. One thing I was not consciously aware of when I started out in science is the importance of networking. I think you can really benefit a lot from networking because it gives you input and lots of new information, you make new friends, you get support. Now I realize that **interaction with people is important at all stages of your career** because it carries you forward and embeds you in the community. I don't want to sound like that this is something, which is a required, planned activity for success; networking should come naturally.

Networking also helps to disseminate your research. If you look at citations of papers, for instance. How many people out there are reading what you're doing? Some papers are highly cited, yes, suggesting that

they are read. But across the range, many are not. There's so much money going into our research. And the more you communicate with others, the better you are at disseminating the results of your work, perhaps also bringing something back to society.

You mentioned communicating and trying to tell people who are not doing science about what research is. Is it possible? Is it really possible to explain biochemistry like what we do in lab meetings? That is, of course, the question many of us wonder about. If I were to be self-critical, I would say that I am not doing enough of this. And it's also not as easy as one might think. But I have seen, for instance during the Corona pandemic, how important it is and what an excellent job many of my colleagues do.

We also see this with climate change. There are researchers at ETH who speak out loudly about this. I really admire them. And I think **we, as biologists, can still do more**. But it takes an effort. And the two of you,⁴ are already doing it!

We are trying!



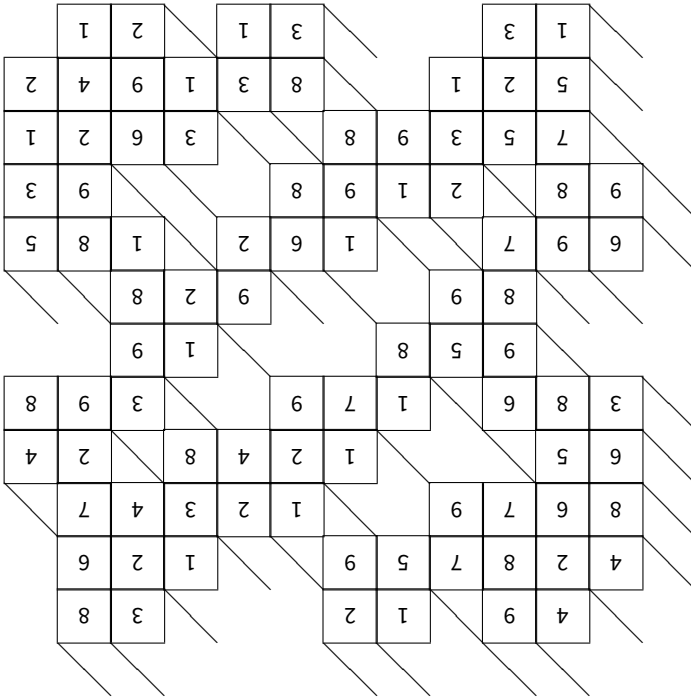
⁴ *Editor's note:* Léona and Lisa

Puzzle Solutions

Samira Neff

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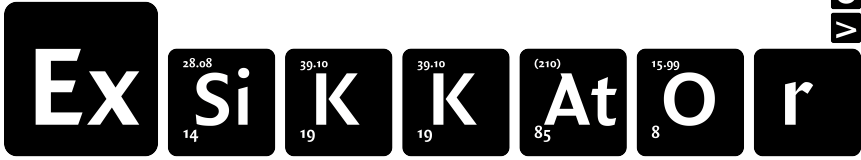




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