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ICE-11: Nobel Prizes in 2022

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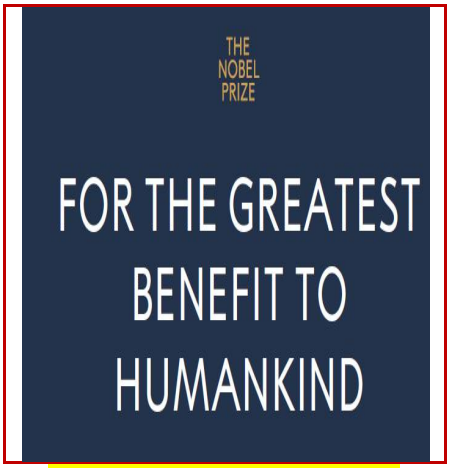

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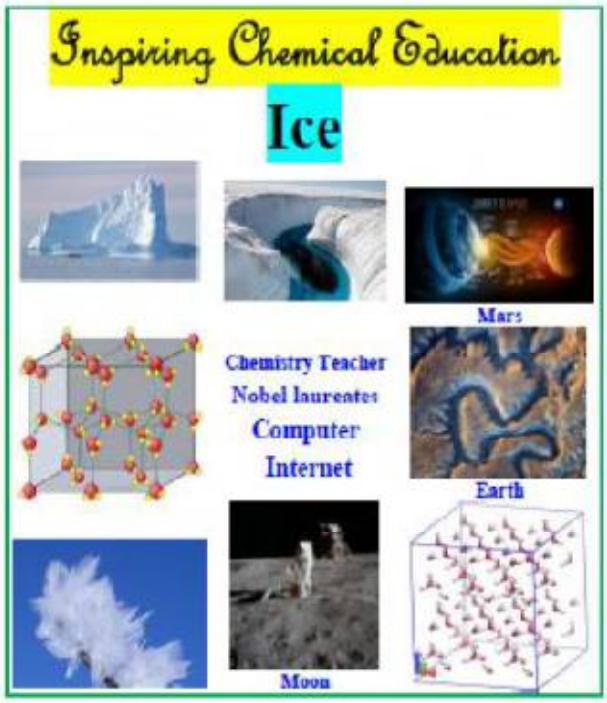


INTRODUCTION

This year (2022), seven Pure science experts, three applied Science practitioners, one peace monger, two peace promoting organisations and one linguist are bestowed with Nobel Prizes under the six categories (**chart. A**).

Chart. A Nobel Laureates of 2022

Categories	Nobel Prize in	# Laureates in 2022	Organization responsible for selection
Pure Science	Physics	3	The Royal Swedish Academy of Sciences for the Nobel Prize
	Chemistry	3	
	Physiology or Medicine	1	Karolinska Institute
Linguistics	Literature	1	Swedish Academy
Humanity	Peace	1+2 organisations	Committee of five persons elected by the Norwegian Parliament
Applied (Economic) science	Economics	3	Royal Swedish Academy of Sciences
Total		---------- 12 +2	

The focal theme of awardees' research, country/year of birth of Nobel laureates, institute-of-employment at the time of announcement of award and share of award are incorporated in Tables 1 to 6. Supplementary information (SI.1) describes Noble prize winners' first responses just after the news reached the awardees. SI-2 incorporates Noble words of Nobel Laureates.

https://www.nobelprize.org/prizes/physics/2022/summary/

2022 Nobel Prize Awardees in Physics
(2022.NPA.Phys)

The Nobel prize in 2022 for Physics (NP.2022.Phys) was conferred on John F. Clauser from USA, Alain Aspect of France and Anton Zeilinger belonging to Austria for their novel experiments with entangled quantum particles (photons), proving inappropriateness of Bell inequalities and also laying foundation for quantum technologies viz. quantum computing, quantum information teletransportation, quantum encryption etc. These three Physicists (Table 1.0) share one-third (1/3) of the prize equally (Table 1.1 to Table 1.3) among themselves.

Table 1.0 Focal theme of Nobel Prize for Physics in 2022

Contributions	! Experiments with entangled photons ! Establishing violation of Bell inequalities ! Pioneering quantum information science	John F. Clauser	J.F. Clauser & Assoc., Walnut Creek, CA, USA
		Alain Aspect	Université Paris-Saclay, Paris, France, École Polytechnique, Palaiseau, France
		Anton Zeilinger	University of Vienna, Vienna, Austria

Backdrop: The universe today (world-now) comprises of ultimate-fundamental-particles (Bosons), quantum-particles (photons, electrons etc.), atoms, nano-assembles (of atoms, molecular species), micro-/macro-Astro-matter (visible-, dark) systems, energy (UV-vis-IR, micro-radiation,…, dark-).

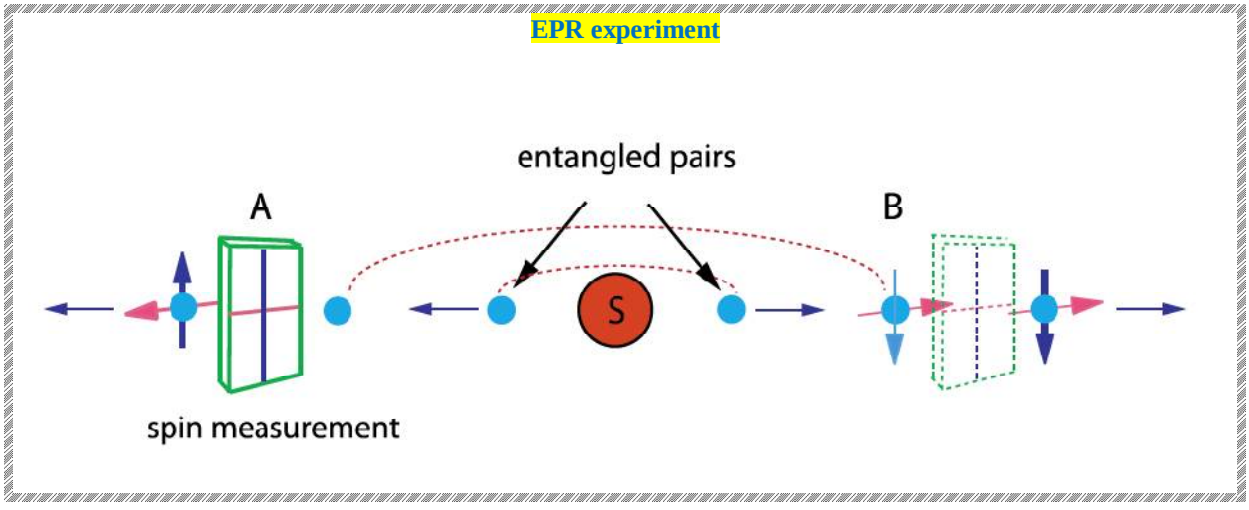
The intra-and inter distances are in the range of atto-to-zillion meters and with fundamental weak/strong forces (gravitational, electro-magnetic, nuclear). No interactions to strongest through weaker ones within the systems and with/within environment/other systems have effects on formation, stability, decomposition in atto-second to billions-of-years in terms of time scale. This is what evolved nature is today from what it was in times-immemorable (at least after big-bang) and will be what it will be. The scientific perception to understand, control, alter matter and energy systems for the benefit of human kind has several light houses/milestones during last few centuries. The standard model of physics, chemical/biological theories, classical/statistical/quantum approaches implemented on computational/communicating/information-transport gadgets are the biproducts with time tested testimony by brainy-experts from all over globe on our mother earth.

Quantum particles: Helium atom has two electrons (called quantum particles in quantum mechanics terminology). They are entangled due to Coulomb interaction. Hylleraas made calculations in 1928 for the spectrum taking into consideration of entanglement.

Entangled states: Consider two quantum particles (photons) are in entangled quantum states. Even if they are far apart, what happens to one of the particles determines what happens to the other particle. For instance, if an observer measures a property (polarisation) of one particle (parallel), then result of an equivalent measurement on the other particle (perpendicular) can be immediately inferred without real/actual measurement. That is in other words, there is no need to check also.

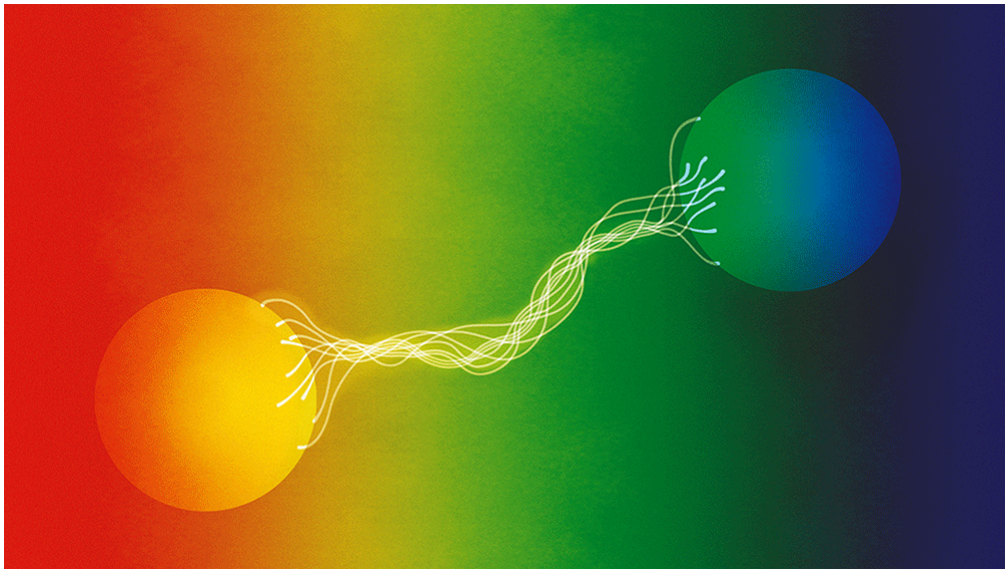
Thought experiments (Expt.That: That to be pronounced as Thought): The noteworthy thought-experiments in earlier days were EPR (Einstein, Podolsky, Rosen.1935), Schrodinger, Bell and CHSH-1969.

Albert Einstein, Boris Podolsky and Nathan Rosen (EPR.1935) theory: EPR thought experiment has a basic notion that distant members of an entangled pair are measured using operators that do not commute. It brought out apparently paradoxical consequences of entanglement between particles. If the distance between them is very large, any interaction between them can be completely ignored. The conclusions posted were "the quantum-mechanical description of reality given by the wave function is not complete". The logical possibility of "when the operators corresponding to two physical quantities do not commute the two quantities cannot have simultaneous reality" was acknowledged.



Schrödinger postulates: Schrödinger considered entanglement as the characteristic trait of quantum mechanics. The entanglement between microscopic and a macroscopic system led to another paradox of Schrödinger's unfortunate cat (which is simultaneously dead in one world and alive in another world).

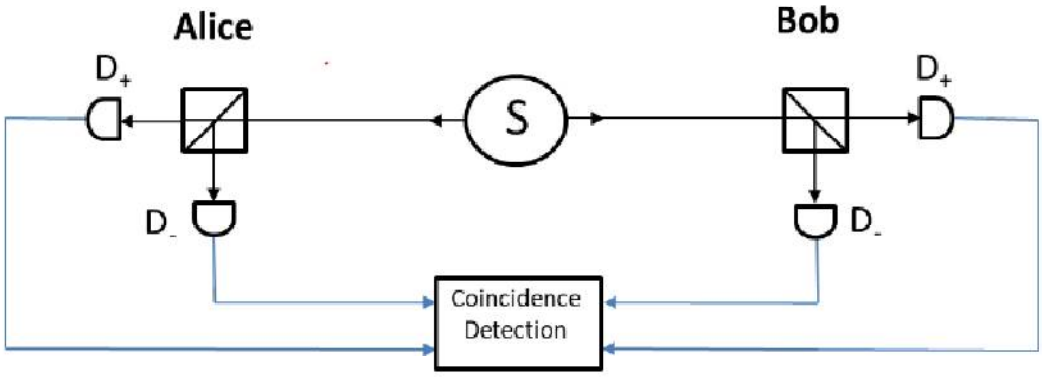
Two or more quantum particles entanglement

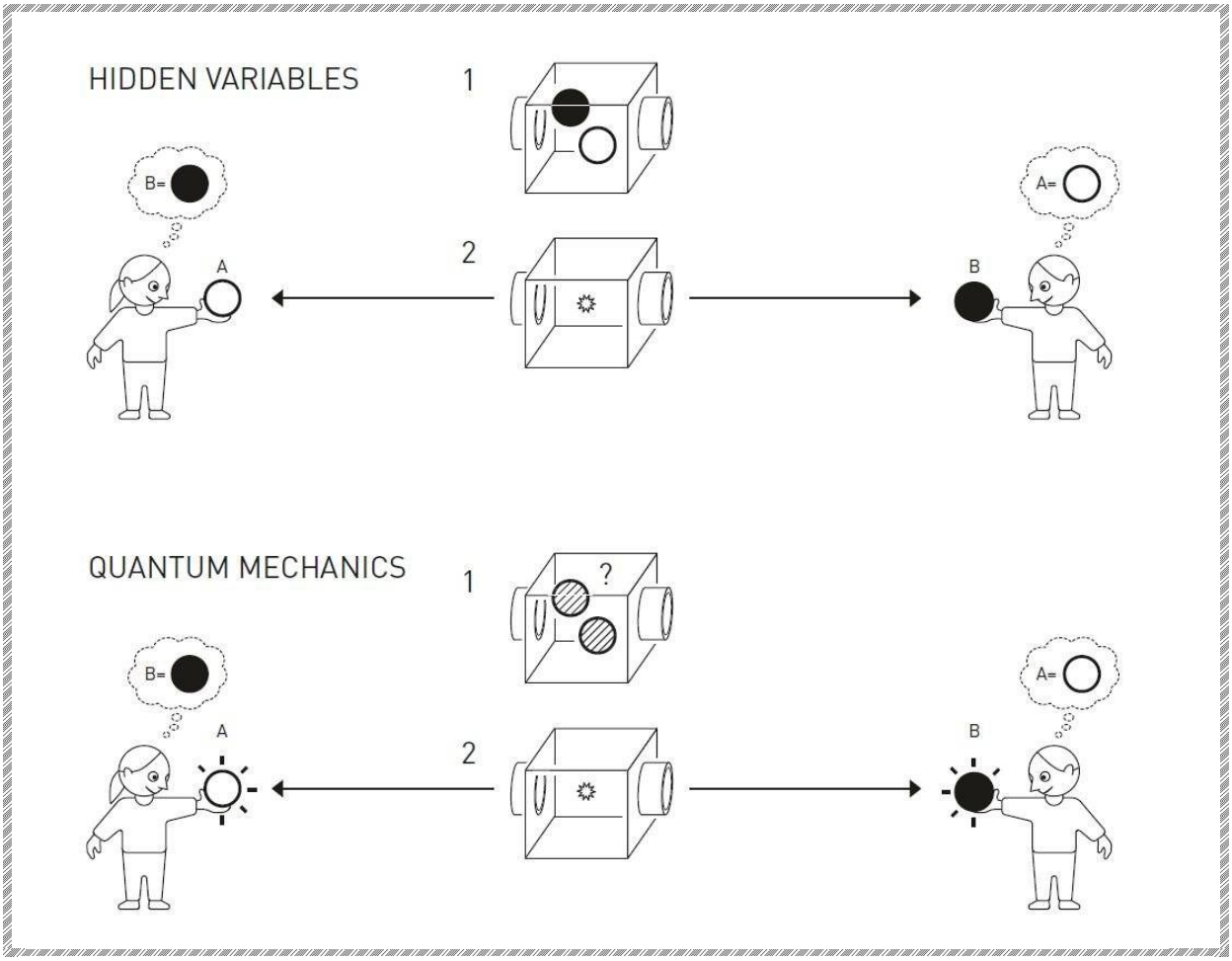


- ✓ Albert Einstein talked about spooky action at a distance
- ✓ Erwin Schrödinger said it was quantum mechanics' most important trait

Hidden variables: More appropriately, hidden variables are procedures or instructions in objects (classical or quantum particles). When an experiment (seeing or monitoring with probe) is performed on the objects, then the procedure tells what is the consequent result. The riddle for a long time was whether correlation of entangled pair is due to hidden variables or quantum mechanics intrinsic trait.

Source S → pairs of entangled photons





Bell era: John Stewart Bell (1928–1990), was a physicist working at CERN, the European particle physics laboratory. He conceived a thought-experiment to arrive at whether the world could be described (by conceptual model) with hidden variables, purely by quantum mechanics or both.

Inequality-Bell.1964: For experiments repeated several times, Bell first derived an inequality for a certain correlation function which is obeyed by any local realist theory. This value must be less than or at the most equal to a specific value called Bell's inequality (that is named after him). QM experiments predicted higher correlation values, thus failing Bell's inequality. He proved mathematically that hidden variable theory does not reproduce all the results of quantum mechanics. A special version of the Bohmian-EPR thought experiment was used in this thesis.

Assumptions: The two observers, Alice and Bob, randomly choose of what to measure independent of each other. This locality condition amounts to making sure that such a message would have to travel with a speed greater than that of light. If this to be true, Alice should not send a message to Bob about whether A1 or A2 is measured. Or in other words, Alice has no influence on choices of Bob. It was shown that for some experimental conditions the predictions of quantum mechanics violate this inequality. Bell showed that all attempts to construct a local realist model of quantum phenomena are doomed to fail. The popular Bell inequality remained as spectacular theoretical discovery.

Limitation: Bell's thought experiment is not suitable for the test, as assumptions made about the detectors are not justifiable for real world equipment.

Local realist model: Local refers to impossibility of instantaneous signaling, limited by the finite speed of light. The term realist means that the outcome of any experiment is completely determined by properties (known as hidden information/variables) of the system.

Inequality-CHSH-1969: John Clauser, Michael Horne, Abner Shimony and Richard Holt proposed a variation of the Bell inequality in the year 1969 (CHSH-1969) overcoming the limitation initial inequality.

Expt.That.CHSH: Alice performs two different experiments denoted as A1 and A2 (Ex: measurement of the spin in two different directions); similarly, Bob can measure B1 or B2. In the framework of realism, outcomes of the measurement on each individual quantum system are well defined although a measurement is not made. Quantum mechanics does not predict the results of the measurements, but they nevertheless should be considered as elements of reality in the EPR sense.

It opened a new window to check CHSH-inequality by laboratory experiment on entangled photons using the then existing approaches/technology. CHSH scenario differs from the EPR thought experiment. But it also fails.

No-cloning theorem: No unitary transformation can produce a copy of an arbitrary quantum state and at the same time maintaining the original. Or, such a cloning operator does not exist since the equation is nonlinear in $|\psi 1\rangle$ and $|\psi 2\rangle$.

Experiments with Instrumental Probes (Expt.Inst_Probe): The progressive intense and technological advanced experiments by Clauser, Alain Aspect and Anton Zeilinger follow.

John F. Clauser

Table 1.1 John F. Clauser (NL.Phys.2022) Noble Contributions		
Procedure	Experiments with entangled photons, establishing the violation of Bell inequalities and pioneering quantum information science	
Discipline	Quantum mechanics	Experimental

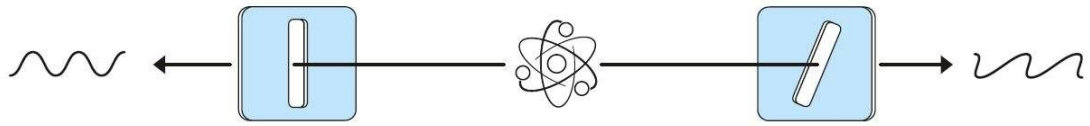
Affiliation	**Nobel Laureate (Physics)** **Photo, Date & place of birth**	**Share**
J.F. Clauser & Assoc., Walnut Creek, CA, USA	John F. Clauser  1 December 1942, Pasadena, CA, USA	1/3
	https://www.nobelprize.org/prizes/physics/2022/clauser/facts/	

John F. Clauser era: Clauser during his Ph.D. program acquired the background knowledge of molecular astrophysics. Yet, he was interested in core-concepts-and-consequences of quantum mechanics. Further, he was aware of Kocher's experimental studies (carried out in 1967 at UC Berkeley) about time correlation between pairs of photons originating from a common source. Kocher could not test Bell's inequality as angles chosen were very close. Clauser went for a post-doctoral position (with Townes in Berkeley in 1969) to work on radio astronomy and search for molecules in the interstellar medium. In the heart of hearts, John Clauser wished to test Bell-CHSH inequality after modifying the experimental setup built by Carl Kocher during his PhD research. With special permission from Townes, Clauser could devote half-of-the-time for Bell test and also Freedman (a doctoral student of Commins) would associate in the research.

Expt. Clauser_Freedman: They found the disadvantage of polarizers in Kocher's equipment leading to prohibitively large time consumed to work at many angles between polarizers. In the modified instrument (which took two years of time) 'pile-of-plates' polarizers were used with increased efficiency, an advantage of increased feasibility to carry out many experiments. The data were recorded for about 200 hours to test inequality in 1972. Two entangled photons at a time were emitted, each towards a filter which measured/tested the polarization. They unequivocally showed that experimental data revealed a clear-cut violation of a Bell–CHSH/Bell inequality and also agreed with the predictions of quantum mechanics.

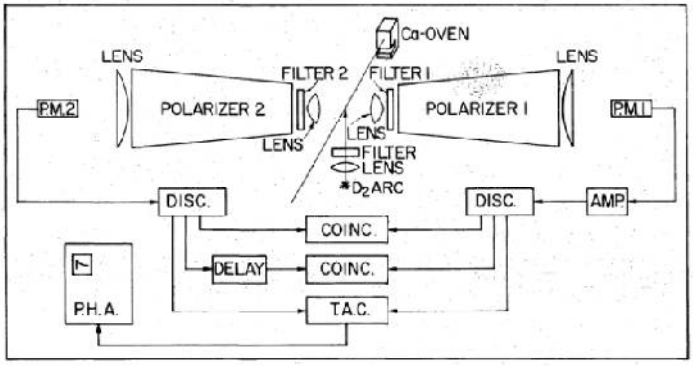
Experimenting with Bell inequalities
These increasingly refined tools bring realistic applications ever closer

1) ***John Clauser***



- Entangled photons Source: Calcium atoms + illuminated light;
- Photons' polarization measurement: Filter;
- Inference: violated Bell inequality;

Apparatus and associated electronics used by Freedman and Clauser



Limitations of Clauser_Freedman Expt: Typical shortcomings in these experiments (although critical) are

- Production and capturing of (quantum) particles were significantly inefficient

- The filters are at fixed angles and thus measurements were pre-set.
  - This poses a stigma that a case may arise, where equipment selected by chance/ in some other way the particles that have high correlation and/or could not pickup others. This raises a doubt that the particles might be carrying hidden information. Proof of absence as well as fixing this loop-hole is a hard-nut-to-break. This is because entwined quantum states are difficult to manage as they are so fragile that it warrants use of individual photons

☞ Remedy: The experiments with new concepts in equipment by Alain Aspect surmounted these loop-holes

Alain Aspect

Table 1.2 Alain Aspect (NL.Phys.2022) Noble Contributions

https://www.nobelprize.org/prizes/physics/2022/aspect/facts/

! Procedure	☞ Experiments with entangled photons ☞ Establishing the violation of Bell inequalities ☞ Pioneering quantum information science

Affiliation	Nobel Laureate (Phys) Photo Date & place of birth	Share
Université Paris-Saclay, Paris, France, École Polytechnique, Palaiseau, France	**Alain Aspect**  15 June 1947, Agen, France	1/3

Alain Aspect era: Alain Aspect, French researcher, in collaboration with Phillipe Grangier, Roger and Jean Dalibard designed experiments with novel instruments/improved techniques (during 1980s), becoming the first experimentalist to avoid the locality 'loophole' in testing for entangled quantum particles (Eg: photons). He could count the photons that passed through the filter and those that did not.

Expt.1. Aspect: Two laser systems were used for direct excitation by two-photon absorption. It proved to be more effective compared to a filtered hydrogen (deuterium) arc lamp.

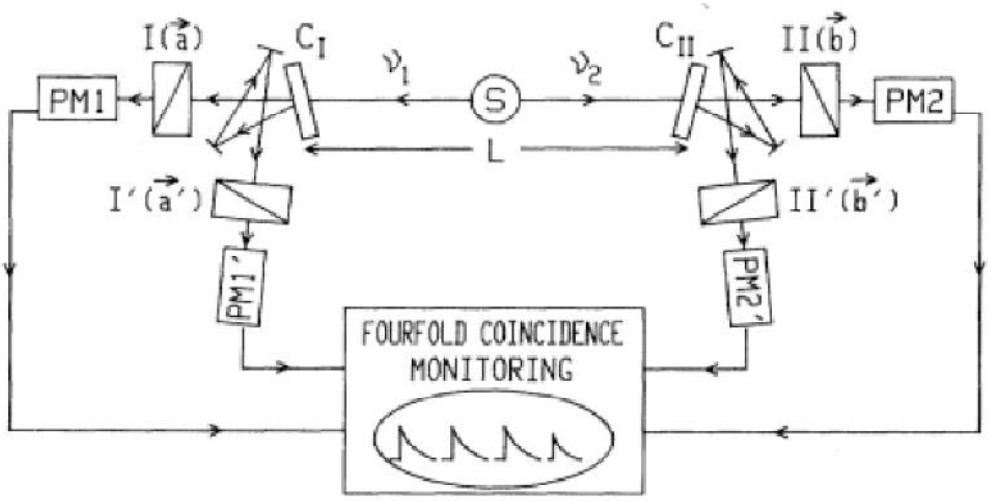
Expt.2. Aspect: Here, two-channel polarizers were used in dichromatic measurements.

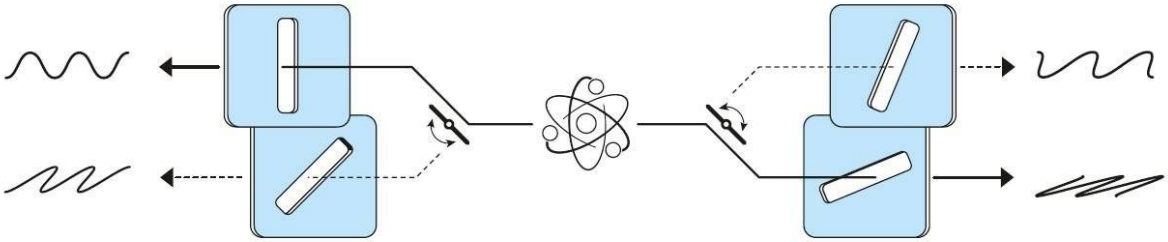
+ Resulted in excellent statistics
+ Largest violation of Bell inequalities in comparison with prior experiments in earlier times

Expt.3. Aspect: Aspect achieved the desired rotation of the orientation of the polarizers, by making use of his methods of 1976 experiments. Earlier, it was thought that was unachievable. Although only single-channel polarizers were used, the optics was very complicated. The experiment resulted in value of 0.101 ± 0.020 (for S) in clear violation of the inequality (five standard deviations). Interestingly, it is in good agreement with 0.112 obtained from the quantum mechanics. This garnered the most attention of higher order scientists.

+ Inequality test was performed under strict local conditions with the observers separated by 400 meters
+ It was made possible to switch the measurement settings after an entangled pair had left its source. Hence, the setting that prevailed when they were emitted does not affect the result.
+ The violation of a Bell inequality was established with very high precision (tens of standard deviations). Freedman–Clauser experiment gave only six standard deviations
+ Independence of observers (Alice and Bob) was ensured. It is achieved by using polarization settings which changed randomly during the time of flight of the photons between the detectors
- Yet, the experiment was not ideal, since the distance between the polarizers was too small to allow for a truly random setting between them

Experiment proposed by Aspect in 1976 → performed with collaborators in 1982





- ✓ **Alain Aspect** experiment: a new way of exciting the atoms so they emitted entangled photons at a higher rate.
- ✓ Switching between different settings possible, so the system would not contain any advance information that could affect the results.

Remedy: Anton Zeilinger's experiments after more than 15 years

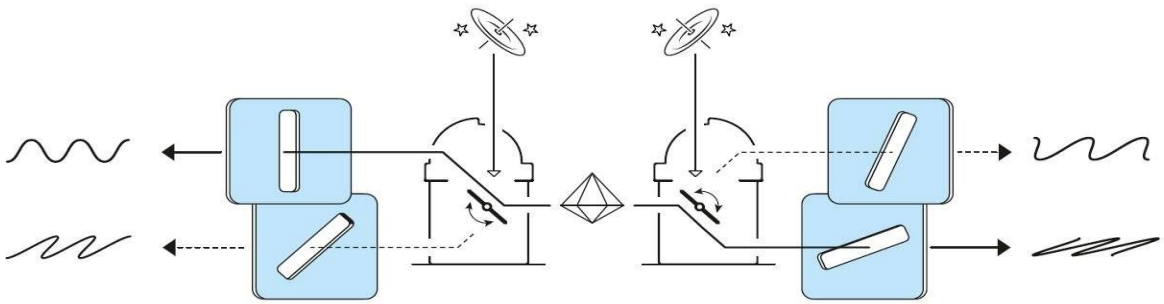
Anton Zeilinger

Table 1.3 Anton Zeilinger (NL.Phys.2022) Noble Contributions

Procedure	Experiments with entangled photons, establishing the violation of Bell inequalities and pioneering quantum information science	
Discipline	Quantum mechanics	Experimental

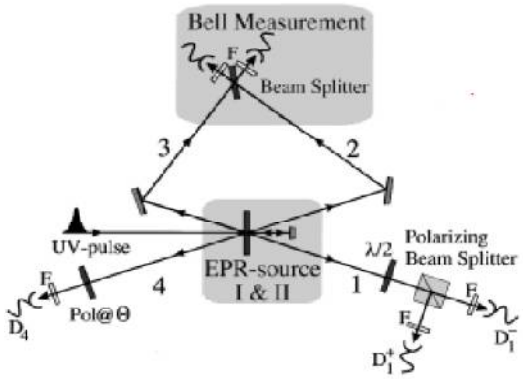
Affiliation	**Nobel Laureate (Physics) Photo, Date & place of birth**	**Share**
University of Vienna, Vienna, Austria	Anton Zeilinger  20 May 1945, Ried im Innkreis, Austria	1/3
	https://www.nobelprize.org/prizes/physics/2022/zeilinger/facts/	

Anton Zeilinger



- ✓ Entangled pairs of photons Source: shining a laser on a special crystal
- ✓ Tool for shift between measurement settings: random numbers
- o Expt. 2: Signals from distant galaxies: to control the filters →
  - + Ensures the signals could not affect each other

Entanglement **between photons 1 and 4**



Anton Zeilinger era: Anton Zeilinger has intense curiosity to understand the universe we all live in. He closed many loopholes in experiments designed for testing Bell's inequality for entangled quantum particles. This resulted in a

+ fringe benefit of rendering quantum cryptography unconditionally secure and
+ ensuring applicability of quantum information.

His research school over decades contributed to development of quantum technologies and applications in diverse but potential quantum information scienceengineering/technology/products (chart 1)

Chart 1 Fundamental Phenomena (in Quantum Information Science and Technology)

Evolution of Quantum Mechanics

- Quantum Mechanics
  - Thought Experiments
  - Experiments with Instrumental probes
- Quantum Chemistry
  - Computational QC

Application Disciplines of QM

- Quantum computation
- Quantum imaging
- Quantum cryptography
- Quantum communication
- Quantum teleportation

QM-Tests

- Tests of quantum mechanics
  - Bell's Inequality
  - CHSH Inequality
- Entanglement
- Quantum nonlocality
  - Ex: three-particle entanglement
    - Extreme demonstration of quantum nonlocality
- Loophole-free tests
  - Bell's Inequality

Quantum-entangled--multi-particle Experiments

- ✓ Multi-particle entangled states
  - GHZ (Greenberger-Horne-Zeilinger) states
  - Generalized GHS →
- ✓ Fundamental tests of
  - Quantum mechanics
  - Quantum information science
  - Quantum computation

Quantum computer One-way quantum computer	Quantum imaging Entanglement-based methods
Quantum computation o Optical quantum computation o Realization of many gates and procedures	Quantum teleportation Independent photons o Single o Multiple

Quantum communication o Long-distance realizations o First long-distance entanglement-based quantum communication expts across the river Danube in Vienna o Many experiments between Canary Islands later	Quantum communication-Recent ✓ World's first intercontinental quantum cryptography link via the quantum satellite Micius o In cooperation with the Chinese Academy of Sciences

Quantum repeaters o Theoretical concept of entanglement swapping o First experimental verification. o Fundamental ingredient for future quantum repeaters	Quantum cryptography o Entanglement-based
o Matter wave interferometry with o Neutrons, atoms, buckyball molecules	

https://www.nobelprize.org/prizes/chemistry/2022/summary/

2022 Nobel Prize in Chemistry

Nobel Laureate (2001.Chem). K. Barry Sharpless, Dr. Morten Meldal and Dr. Carolyn R. Bertozzi shared the Nobel prize in Chemistry of 2022 (NP.Chem.2022) amongst themselves equally. Dr. Meldal and NL. Sharpless independently developed click chemistry around the year 2000. Dr. Barozzi's contributions resulted in a transient discipline named bio-orthogonal chemistry using the theme of Click chemistry concept. The Chairman of the Nobel Committee for Chemistry, Prof. Johan Åqvist, asserts that this year's Prize in Chemistry deals with not overcomplicating matters. But working with what is easy and simple. It is extensively demonstrated Functional molecules can be built even by taking a straightforward route.

Table 2.0 Focal theme of Nobel Prize for Chemistry in 2022

Methods Development	! Click chemistry		NL. K. Barry Sharpless	Scripps Research, La Jolla, CA,
			Dr. Morten Meldal	Univ. of Copenhagen, Denmark
	! Bioorthogonal Chem.		Dr. Carolyn R. Bertozzi	Stanford University, CA, USA

Backdrop: Human-life on earth in our solar system is a proof-of-concept of supreme ability of nature in creation and evolution of chemical-complexity. The magnificent molecular structures found in plants, microorganisms, animals, birds and homo-sapiens are just a testimony of functional operations from digestion, reproduction and genetic information transfer to communication and defense (predators, diseases, invaders) with non-life molecules. It is all as a result of zillion interactions in the universe for over 13.8 billion years and also on the entire planet, earth, in over nearly 4.5 billion years. The expression of human beings with evolved brain (called scientists) using rational tools is the knowledge with major divisions Physics, chemistry and biology.

The study of making and breaking of covalent bond within a molecule or between molecules (containing chemical atoms) is chemistry and a formerly trained human expert is called a chemist. Chemistry is thus a sub-set of nature and not whole of it (in time and space since big-bang), but will continue into future with a pretty long life-span (of billions of years).

Alchemy, medieval chemical science and speculative philosophy of 17th century, had targets to turn lead into gold, discovery of a universal cure for any disease and finding means of indefinitely prolonging life. It had a natural death because of ambitious brain-wave of dreaming to realize a process or power even if is inexplicable or a result/consequence of mysterious transmutation.

Modern Chemistry started in 18th century, and nature was adopted as their role-model. Efforts in the direction of preparation of chemical compounds (imitating those nature already made) revolutionized the experimental methods, knowledge and the very basis of discipline. Chinese medicine and Indian Ayurveda had their roots in naturally occurring materials with medicinal (curative) properties had tremendous impact on pharmaceutical science and inspiring chemists in general. The cumulative intense research of the last two (19th and 20th) centuries brought out high-end tools and knowledge bases to synthesize astonishingly complex structures with high fidelity.

Now, in 21st century, Carbon-valley (mostly with organic chemical molecules) is a science-wonder other than silicon-valley, popular since 1960s. The man-made laboratory of this decade comprises of adaptive-intelligent-pipe-line-of-functional_robotic_chemical_sythesis-machines. The knowledge-valley with several knowledge-Inns hoard knowledge-bases of methods-procedures-Artificial intelligence tools is back-bone for activity of to-day's chemical_expert_scientist. The synthetic organic chemists (who are also specialists in pharmacy, biology, electronics) now make almost any structure we can imagine/find in nature. Yet,

- The procedures are generally time consuming and very expensive cost wise
- The methods require stringent experimental conditions for every step of the process to reach the final product
- many complex processes demand for linking methods which are difficult and cumbersome

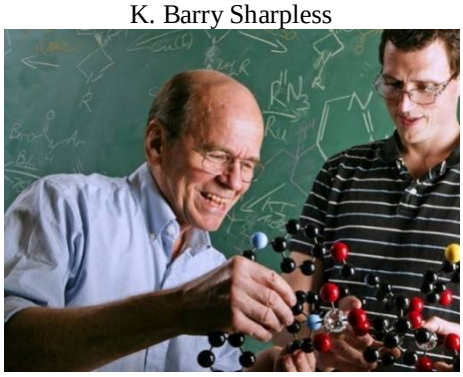
Partial solution: Skilled and talented chemists learn and master these methods to perfection. However, the learning process require significant effort, time and guidance from experts

Ultimately, respecting Pareto-optimality, the goal of synthesis is not making of compounds/materials at laboratory/industrial scale but of functions, that too with maximum number of desirable and at the same minimum of undesirable properties.

NL. K. Barry Sharpless

Table 2.1 Focal theme of K. Barry Sharpless (NL.Chem.2022)

Method Development	! Click chemistry		☞ K. Barry Sharpless

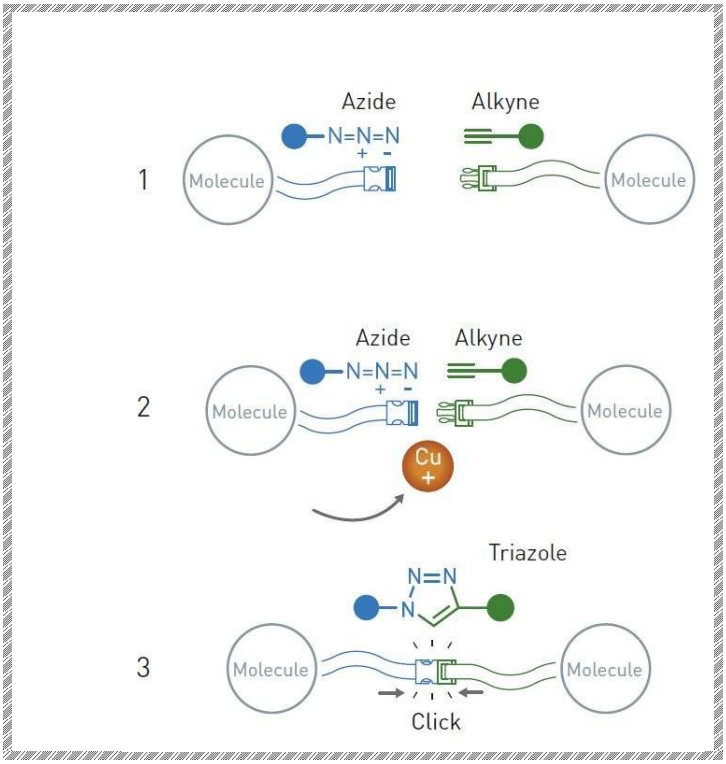
Affiliation	Nobel Laureate (Chem) Photo, Date & place of birth	Share
Scripps Research, La Jolla, CA, USA	K. Barry Sharpless  28 April 1941, Philadelphia, PA, USA	1/3

Barry Sharpless was awarded: The Nobel Prize in Chemistry of 2001 also

K. Barry Sharpless era: The complex networks of carbon atoms with bonds between them are basic building blocks of bio-molecules of life chemistry with diverse functional expressions. Mother nature brought out methods to perform these tasks during evolution over billions of years. But, even to an expert chemist with start-of-art-science, it is beyond realization in toto. One of the reasons could be that carbon atoms from different molecules often lack a chemical drive to form bonds. An artificial activation (through chemical reactions) often leads to numerous unwanted side reactions and a costly loss of material in each step of sequential organic synthesis plan. But, two centuries' efforts in synthesis of molecules resulted in a plethora of possible methods, of course, each reaction with specific scopes and limitations.

Barry Sharpless opined that instead of trying to wrangle reluctant carbon atoms into reacting with each other, a collection of "streamlined" preparation processes, where each compound could be made using a limited set of highly robust and efficient reactions would be preferable. He forecasted that preparation of sought-after structures can be achieved by resorting to more general, robust and high-yielding reactions at hand. Iff it would be successful at laboratory bench studies, this approach speeds up the manufacturing process. It would also lead to higher amounts of pure products with minimum bi-products. Under the guidance of K. Barry Sharpless (2001-NL-Chem), attempts started in the laboratory with smaller molecules which already had a complete carbon frame. These simple molecules were then successfully linked together using bridges of nitrogen atoms or oxygen atoms, opening a new window in the castle of organic molecular synthesis.

Click chemistry concept (CCC): Sharpless presented at American Society meeting in 1999 the results of his brain-wave emerged from brain storm churning of the state-of-knowledge-experiments on organic chemists' synthesis for two centuries and nature's evolution play of billions of years. He coined the term click chemistry. It can be illustrated with analogy of flat-pack application of IKEA and belt-buckle coupling. The details are published in 2001 in a review paper entitled 'Click chemistry: diverse chemical function from a few good reactions'. This noble approach changed chemistry to a new horizon and became one of the sought-after tools in the arsenal of synthetic-organic-chemistry. The click-chemical-reaction approach relied on a limited set of highly robust reactions. And, now it is in widespread use for globally to link molecules together in a simple manner to efficiently synthesize functional (complex) moieties in development of pharmaceuticals, mapping DNA and creating more fit materials.



Ideal Click reaction (CC.AAC): Barry Sharpless reported that reaction between azides and alkynes in aqueous medium in presence of copper as a catalyst, as an ideal, modular, elegant, efficient, potential and reliable template. The procedure to link two molecules is simple: Azide is introduced in one molecule and alkyne in other. The two molecules are then swapped together in presence of copper ions. This copper catalysed azide-alkyne cycloaddition is the crown jewel of click chemistry.

Applications of click chemistry	
o Enzyme inhibitors and receptor ligands o Antimicrobials o Biomacromolecule conjugates o Tissue regeneration matrices o Agents to map complex biological processes o Diagnostics o Sensing elements o Pharmaceuticals o Anticancer agents	Various macromolecular Materials o gels, polymers, etc. o Herbicides, o Photostabilizers, o Brightening agents o Corrosion retardants

Morten Meldal:

Table 2.2 Focal theme of Nobel Prize for Chemistry in 2022			
Method Development	! Click chemistry		☞ Morten Meldal

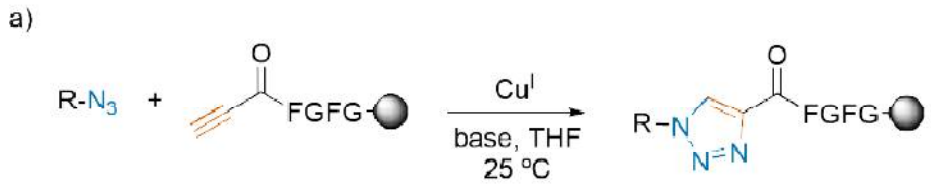
Affiliation	Nobel Laureate (Chem) Photo, Date & place of birth	Share
University of Copenhagen, Copenhagen, Denmark	Morten Meldal  1954, Denmark	1/3

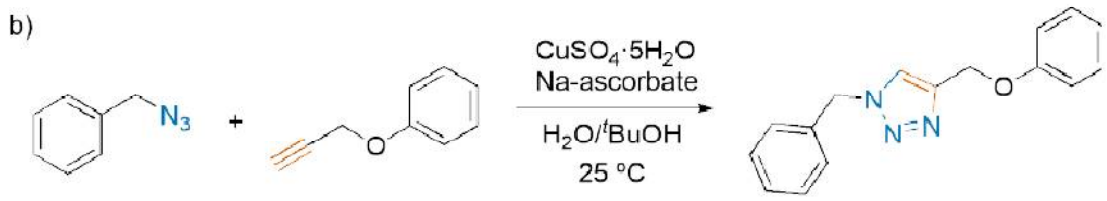
Morten Meldal era: The perception of Meldal with his third eye (of knowledge) is that "reality (Nature) is much more complex than the chemists (in general scientists) are able to comprehend and imagine. But chemistry is a tool to describe reality and probe to sense products, processes in the dynamic nature in spacio-temporal domain.

Around beginning of this century, he developed very large molecular libraries containing hundreds of thousands of entries with a goal to shortlist agents which block pathogenic processes. Meldal and his associates were carrying out the reaction with an alkyne with an acyl halide in presence of copper. It is a purely routine organic smooth reaction. When they looked for the expected product, they found alkyne had reacted with the wrong end of the acyl halide molecule, a surprise. It was sorted out that there was an azide group at the end of alkyne. So there was a reaction between azide and allyl resulting in the product triazole with a ring-shaped structure. This was totally an unexpected product, reaction. Earlier attempts (without copper catalyst) to prepare triazoles yielded undesirable side products, and hence the present experimental was a Eureka moment.

Copper-catalysed reactions

a) Meldal and coworkers





b) Sharpless and coworkers

F: phenylalanine, G: glycine, , THF: tetrahydrofuran, tBuOH: tert-butanol, filled circle: solid support

Parallel Independent success: In presence of copper, only single compound (triazole) is formed from acyl halide and alkyne azide. The other possibility i.e. acyl halide should have bonded to the alkyne did not arise rendering the reaction exceptional where copper ions controlling molecular processes and clean with a single product. This research out-come was presented at a symposium in San Diego, in June 2001. In 2002, the success of reaction with a number of different molecules was published in a journal.

Carolyn Bertozzi

Table 2.3 Focal theme of Nobel Prize for Chemistry in 2022

Method Development	! Bioorthogonal chemistry ! Catalyst free Click chemistry		☞ Carolyn Bertozzi

Affiliation	Nobel Laureate (Chem) Photo, Date & place of birth	Share
Stanford University, Stanford, CA, USA	Carolyn Bertozzi  Selfie from Carolyn Bertozzi right after the press conference on the day of the announcement of the Nobel Prize in Chemistry, 5 October 2022 1966, USA	1/3

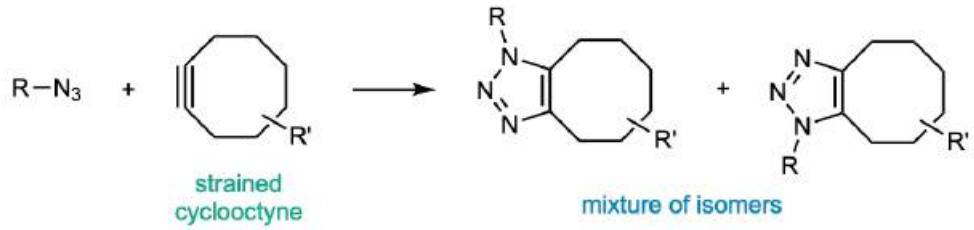
Carolyn Bertozzi era: Sialic acid is one of the sugars that build up glycans in biological cells. Bertozzi was inspired to hear from a German Scientist that he succeeded in making the cell to produce an unnatural variant of it. It sparkled an idea in her mind to pursue cells to make sialic acid with a chosen type of chemical handle. If it is realized, it would become possible to attach fluorescent molecule to the handle. The light emitted would be a wonderful probe to map where the glycans were hidden in the cell. Although Bertozzi started mapping glycan that attracts immune cells to lymph nodes in early 1990s, lack of appropriate tools slowed down the pursuit, but a positive benefit was acquiring a deeper knowledge. By 1997, she proved that her idea yielded fruits. Later, in 2000, Bertozzi had another breakthrough of finding azide as an optimal handle. She introduced the azide to the cells' glycans which can be introduced into living creatures. It has no hazardous effect azide does not interact with the cells. She intelligently modified Staudinger reaction and used to connect fluorescent molecule to the azide.

+ Azide as chemical handle had a lot more benefits
+ An add on to the important gift to biochemistry

Bertozzi, still not contented with the progress, probed further. She was aware of new era of innovative 'click chemistry' propitiated independently (at about the same time year 2000) by Barry Sharpless and Morten Meldal. But it cannot be mapped in toto in her research pursuit as copper ions are toxic for life-systems. After, a deep search of literature, she found that cyclic alkyne reacts with azides in almost explosive manner without any catalyst (like copper). The strain in the ring creates so much energy which controls the reaction to run smoothly.

Strain-promoted alkyne-azide cycloaddition (SPAAC): In 2004, Bertozzi reported strain-promoted--alkyne-azide—cycloaddition reaction implemented in the cells. This can also be called catalyst (copper)-free--click reaction (CF.CR) or strain-accelerated click reaction (SA. CR). It was used to track glycans.

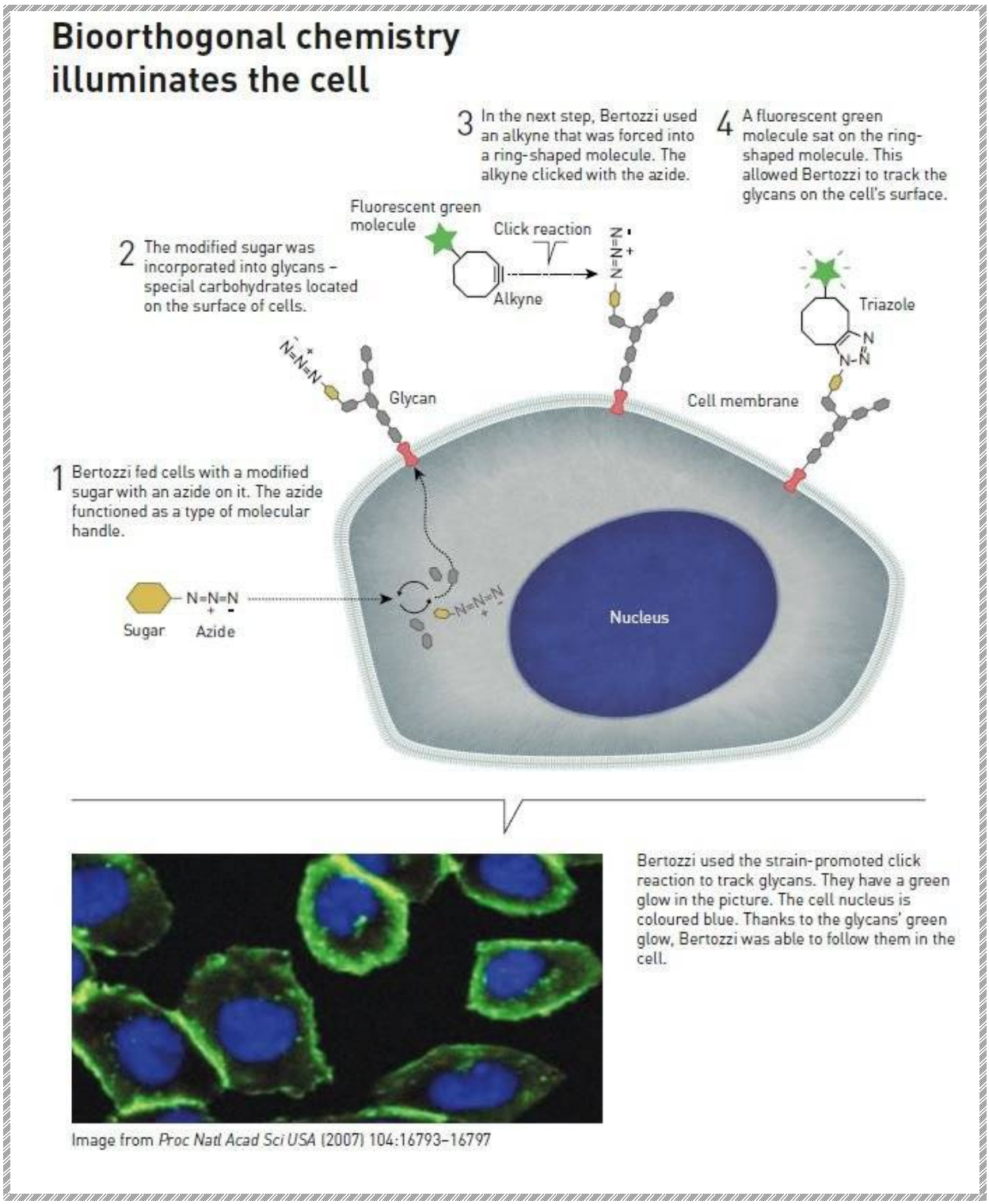
Strain-promoted azide-alkyne cycloaddition (SPAAC)



Refinement of Click reaction: Bertozzi developed click reactions which occur without disturbing the normal chemistry of the cell. They find use inside living organisms. Recent efforts of Bertozzi and other researchers widened the scope of application of SPAAC in cell environments, disease processes etc.

Bio-orthogonal reactions: In mathematical parlance, two vectors are orthogonal, if the angle between them is 90degrees, for example X and Y axis in 2D-systems. Two Nobel Laureates of chemistry (George Barany and R.B. Merrifield, NL.Chem. 1984) described an 'orthogonal system' as 'a set of completely independent classes of protecting groups … [where] each class of groups can be removed in any order and in the presence of all other classes. In peptide synthesis, the term 'orthogonal' stems from studies on protecting group chemistry. It distinguishes the mutually exclusive reactivity of different protecting groups under specific deprotection conditions.

Bertozzi introduced the term 'bio-orthogonal reactions' around the year 2000 for chemoselective reactions in cells of biological systems. The primary concern is that they proceed under physiological conditions and do not interfere with, or not affected by any of surrounding biological processes. Thus, normal chemistry of the cell continues without any disruption and at the same time with a possibility of chemical modification of required molecules within living cells. Chemoselective ligation, orthogonal coupling, and native chemical ligation terms of relevance in orthogonal chemical processes.



Academic profile of Carolyn Bertozzi		
AB	Chemistry	Harvard University (1988)
Ph.D.	Chemical synthesis of oligosaccharide analogs	UC Berkeley
Postdoctoral work	Activity of endothelial oligosaccharides in promoting cell adhesion at sites of inflammation	UC San Francisco

Employment of Carolyn Bertozzi		
1996	UC Berkeley	Faculty
2000	Howard	Investigator, Hughes Medical Institute
June 2015	Stanford University chEM-H (Chemistry, Engineering & Medicine for Human Health) -- Interdisciplinary Institute	First faculty
Now	Stanford chEM-H	Baker Family Director

Expertise of Carolyn Bertozzi	Chemistry and biology
Inventor	Bioorthogonal chemistry Modified Click Chemistry

Bio-orthogonal reactions. Applications

- Molecular imaging and drug targeting
  - To map cells functioning globally
  - Improvement to diagnose cancer
  - Targeting Cancer Pharmaceuticals
- ! Immuno-oncology
- Developed new therapeutic modalities
  - o For targeted degradation of extracellular biomolecules
    - ! Antibody-enzyme conjugates
    - ! Lysosome targeting chimeras
    - ! Lytacs Ngly1 deficiency, a rare genetic disease

https://www.nobelprize.org/prizes/medicine/2022/summary/

2022 Nobel Prize in Medicine or Physiology

2022 Nobel Prize in Physiology or Medicine: This year's Noble prize in Medicine (NP.Med.2022) is conferred solely on Swante Paabo born in Sweden 1955 to Sune Karl Bergström (1916-2004), a Nobel Laureate in Physiology or Medicine of 1982 and Karin Pääbo (1925–2013) Estonian chemist. She escaped from the Soviet invasion in 1944 and arrived in Sweden as a refugee during World War II. Sune Bergström was a biochemist and worked on prostaglandins. In 1975, he was appointed as chairman of Board of Directors to the Nobel Foundation Stockholm. Paabo is carrying out the research now at Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany and Okinawa Institute of Science and Technology, Okinawa, Japan. Narasinga Rao and Sambasiva Rao reported the research details of NP.Med.2022 in a micro-review [communicated].

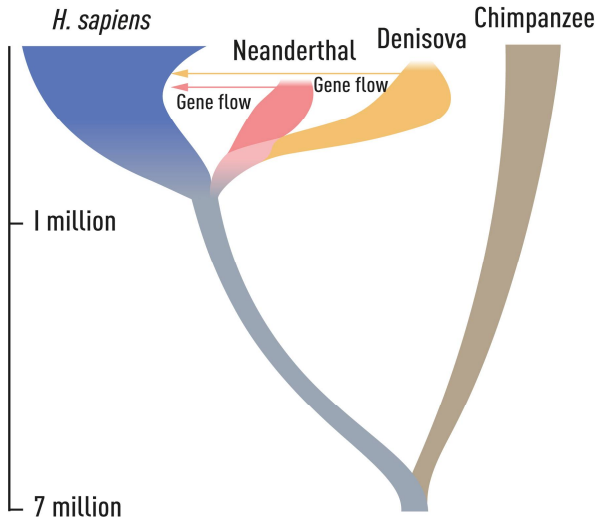
https://www.nobelprize.org/prizes/medicine/2021/summary/

Table 3.1 Focal theme of Nobel Prize for Physiology or Medicine in 2022

! **Discovery**	☞ Concerning the genomes of extinct hominins and human evolution	🕮 Svante Pääbo

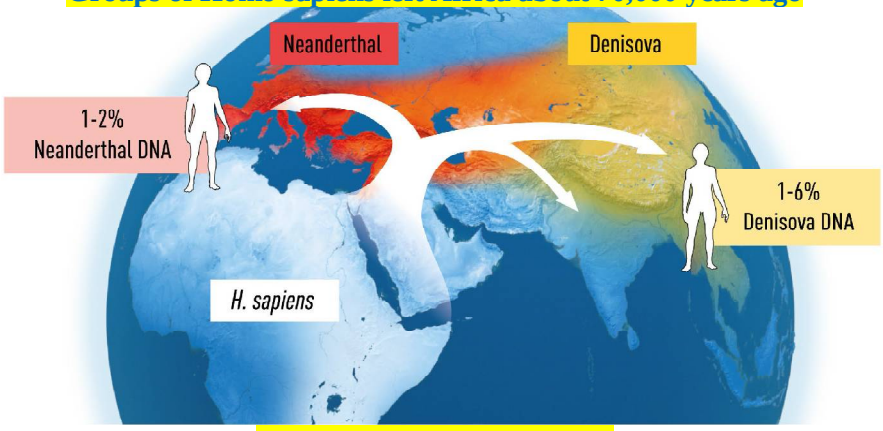
Affiliation	Nobel Laureate (Med) Photo Date & place of birth	Share
o Max Planck Institute for Evolutionary Anthropology, Leipzig, Germany o Okinawa Institute of Science and Technology, Okinawa, Japan	Swante Paabo  Born: 20 April 1955, Stockholm, Sweden	1/1

Phylogenetic tree



Development and relationships among Homo sapiens, extinct hominins and chimpanzees

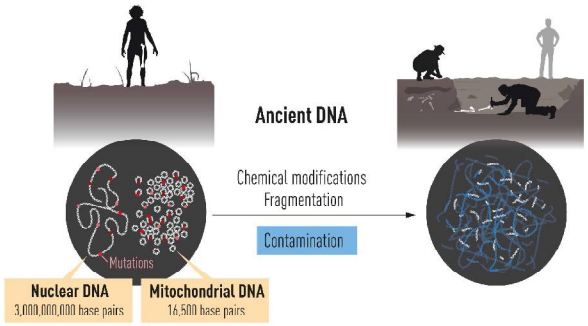
Groups of Homo sapiens left Africa about 70,000 years ago



Spread out across the world.

- Where do we come from?
- How are we related to the kinds of humans who came before us?
- What makes us Homo sapiens special?

When an organism dies, its DNA begins to break down → eventually only small amounts remain



Those traces become mixed with DNA from other organisms, such as bacteria

https://www.nobelprize.org/prizes/literature/2022/ernaux/facts/

2022 Nobel Prize in Literature

The Nobel prize for Literature of 2022 (NP.Lit.2022) is conferred on Annie Ernaux of French origin for her courage and clinical acuity with which she uncovers the roots, estrangements and collective restraints of personal memory.

Table 4: Nobel Prize of 2022 in Literature

Residence at the time of the award	Nobel Laureate (Literature) Photo, Date & place of birth	Share
France	Annie Ernaux  1st September 1940, Yvetot, France	1/1

Annie Ernaux

Literature

- ✓ Nobel Award News (NaN: Not a number)
- ✓ I only learned that I received the prize around one o'clock.
- ✓ How NaN reached NL
- ✓ CP: Good evening. My name is Claire Paetkau. We have a tradition here every year to do short telephone interviews with the new laureates. Would you be available for a quick conversation?
- ✓
- ✓ Doing actually then (DAT)
- ✓ AE: I was in the kitchen, where there is a radio.
- ✓ I wanted to listen to the radio to find out who had won the Nobel Prize. Voilà!
- ✓
- ✓ First action/reaction/expression (Fare)
- ✓ I answered the press what it means for me to receive the prize,
- ✓ It's a great responsibility and at the same time an honour.
- ✓ But that precisely because of this honour I have more responsibilities regarding… regarding my engagement in writing.
- ✓ AE: Yes, it's obviously very surprising. All the more because I was alone.
- ✓ It's like… I will give you a comparison.
- ✓ You are in the desert and there is a call that is coming from the sky. That was sort of the feeling I had.

www.nobelprize.org/prizes/peace/2022/summary

Nobel Prize in Peace 2022 (NP.Pce.2022)

The Nobel prize in 2022 for Peace (NP.2022.Peace) is conferred on Ales Bialiatski, human rights advocate from Belarus, and two peace monging Ukrainian human rights organizations namely Memorial and Center for Civil Liberties.

Table 5 Focal them of Nobel Prize for Peace in 2022

Obj_achieved	▪ Promoted the right to criticise power and protect the fundamental rights of citizens ▪ Made an outstanding effort to document war crimes, human right abuses and the abuse of power ▪ Demonstrated significance of civil society for peace and democracy	o Ales Bialiatsk o Memorial o Center for Civil Liberties

www.nobelprize.org/prizes/peace/2022/summary

Residence at the time of the award	**Nobel Laureate (Peace)** **Photo, Date & place of birth**	**Share**
Belarus	**Ales Bialiatski**  Born: 25 September 1962, Vyartsilya, Karelia, Russia	1/3
	www.nobelprize.org/prizes/peace/2022/bialiatski/facts/ …	

Organisation	**Nobel Prize (Peace)** **Name, Photo**	**Share**
Founded: 1987, Moscow, Russia	**Memorial** 	1/3
	https://www.nobelprize.org/prizes/peace/2022/memorial/facts/	

Organization	**Nobel Prize (Peace)** **Name, Photo**	**Share**
Founded: 2007, Kyiv, Ukraine	**Center for Civil Liberties** 	1/3

www.nobelprize.org/prizes/peace/2022/center-for-civil-liberties/facts/

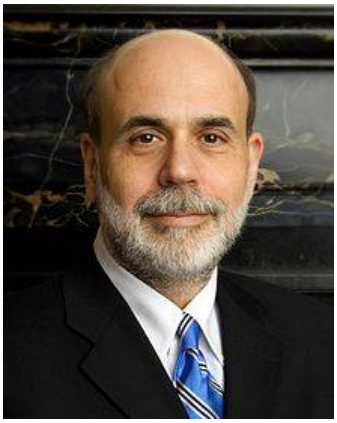
https://www.nobelprize.org/prizes/economic-sciences/2022/summary/

2022 Nobel Prizes in Economics

The Nobel prize in Economics of 2022 (NP.Econo.2022) is shared between Philip Dybvig, Douglas W. Diamond and Ben S. Bernanke for their for researches on banks and financial crises.

Table 6. Focal theme of Nobel Prize for Economics in 2022

Research on	Banks and financial crises

Affiliation	**Nobel Laureate (Economics)** **Photo** **Date & place of birth**	**Share**
The Brookings Institution, Washington, D.C., USA	Ben S. Bernanke  December 13, 1953, Augusta, Georgia,	1/3
University of Chicago, Chicago, IL, USA	Douglas W. Diamond  October 1953	1/3

Washington University, St. Louis, MO, USA	Philip Dybvig  22 May 1955	1/3

Information Supplementary (Is)

SI.1: First Response of Noble Prize Winners of 2022

Interviewer (Telephonic)	Dr. Adam Smith (AS) Chief Scientific Officer of Nobel Prize Outreach Nobelprize.org, the website of the Nobel Prize

Svante Pääbo  Medicine	Nobel Award News (NaN: Not a number) ! I got call from Sweden o I, of course, thought it had something to do with our little summer house in Sweden. o I thought 'oh the lawn mower has broken down or something' ! But, that was Nobel prize award news Doing actually then (DAT) ! Then I was just gulping down the last sip of tea to go and pick up my daughter at her nanny where she has had an overnight stay First action/reaction/expression (Fare) ! Didn't initially believe he had won the Nobel when he got the call from Stockholm. ! He "at first thought it was an elaborate prank developed by people in his group" ! He was still digesting the news ! ! AS: You sound remarkably calm and collected ! SP: I've discussed it with my wife Linda at length already, I must admit

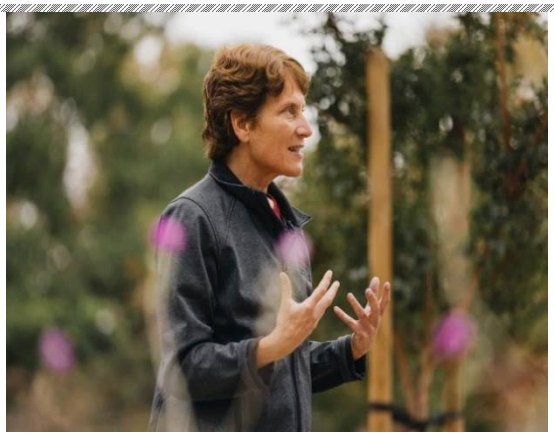
	! AS: It sounds like your wife is a calming influence ! SP: Yes, certainly, she is

Alain Aspect  Physics	Nobel Award News (NaN: Not a number) ! Alain Aspect was told that he was awarded the Nobel Prize in Physics, ! Doing actually then (DAT) ! The news reached him during a meeting with the Physics department of l'Académie des Sciences ! ! First action/reaction/expression (Fare) ! Well, it's of course a surprise o because we know that there are so many outstanding physicists who deserve it Humility ! I'm certainly not at the same level as these people who have really totally changed the physics ! But then I am proud to be of the same league of course [Laughs]

Anton Zeilinger  Physics	Nobel Award News (NaN: Not a number) ✓ AS: How did you hear the news? ✓ AZ: Just when the… when the secretary general called me, called me, yes. Doing actually then (DAT) ✓ AZ: This was at 11 o'clock. I was sitting at home working on some paper, you know, and it came the phone call, yeah. First action/reaction/expression (Fare) ✓ AS: And what was your first reaction or action on hearing the news? ✓ AZ: I was speechless! ✓ I'm still, I'm still kind of… ✓ I don't know what to say ✓ I mean this is a fantastic appreciation!

John F. Clauser  Physics	Nobel Award News (NaN: Not a number) AS: You have… I guess you have already been, as you said, on calls all morning. JC: So, ✓ I got waked up at three in the morning. ✓ So far it took me over an hour to even get my pants on, there were so many phone calls. ✓ Ah yes! Took me a long time before I even got a cup of coffee. AS: Well, that's slow progress with the regular things in life but nice, nice distractions. This work that's been awarded, I mean, AS: Well, first of all many, many congratulations on the award. JC: Thank you. AS: My goodness, what a start to a very long day.

Carolyn Bertozzi	Nobel Award News (NaN: Not a number) ✓ All of a sudden, you know, the phone is jarring me awake ✓ Doing actually then (DAT) ✓ I was probably asleep for not even two hours ✓ .First action/reaction/expression (Fare)



Chemistry

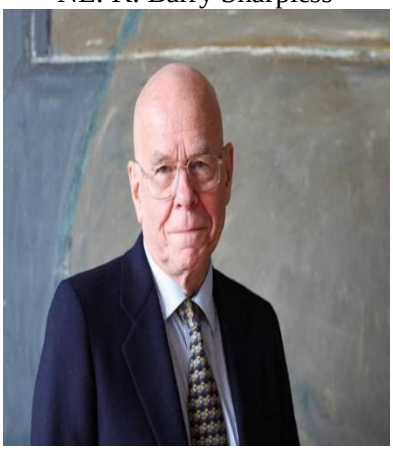
- ✓ I mean, it's insane, you know
- ✓ I'm thinking 'are you kidding me?'

AS: How do you… how do you feel about having the Prize?

- ✓ CB: Well, I'm still I think in shock
- ✓ But it's really exciting for me to kind of be there, on the same-list as Barry Sharpless and Morten Meldal. The two of them are among my chemistry heroes.

- ! To be among them is just a huge honour for me
- ! MM: Bertozzi has such a broad knowledge of both chemistry and biology, and knows how to utilise her chemical knowledge in a very exquisite way in understanding biology.

NL. K. Barry Sharpless



Chemistry

Nobel Award News (NaN: Not a number)

AS: It's… it's just such a… such a joy to hear you. And here we are again – second time!

- ✓ BS: That's right, yeah, I can't… Things are… I'm a little bit snow blind right now from no sleep, so…

AS: It's just so nice to hear you, and to be part of this extraordinary day when you're receiving your second Nobel Prize.

- ✓ BS: Okay, because it's really… it's lucky, in some other ways you don't know about, and that is, you know, I sort of changed fields.
- ✓ By the time I won the first I was doing… trying to do click chemistry.
- ✓ Now something's happened again here… something changed me, got me, some accidental discoveries in materials that are… that looks pretty important for energy.

NL. K. Barry Sharpless

- ! AS: whenever one talks to you, we're always talking about the last thing you did, and
  - o you're always talking about the next thing you're doing,
    - ! because you're just so chemically inventive.
- ! And I suppose that's what people will want to know: what is it about you Barry that makes you so, so inventive?
- ✓ BS: I kind of wonder about that because
- ✓ I'm very… in some ways very slow and, but,
- ✓ actually I think the easiest… I was just looking today, trying to describe for this thing I going to have to do at 1.30,
- ! say a few things about what do people want to know. They mostly
- ! want to know human things, like
- ! how amazing were you that this happened or that happened.

+ One of my favourite quotes is by Einstein 'If at first the idea is not absurd, then there's no hope for it'. Now, that's a weird one, right?

Morten  Chemistry	Nobel Award News (NaN: Not a number) ✓ I was called this morning by committee, and they congratulated me ✓ First action/reaction/expression (Fare) ✓ It was really a surprise Was just total surprise, ✓ I was not expecting it at all ✓ I think that there's a lot of research that goes by which are, is very exciting, and ✓ sometimes you just by serendipity have an orange falling into your turban and you have a very nice idea that can make a lot of people have an easier life in their research, or even in the, you know, in public.

Morten Meldal

AS: people in general tend to view chemistry – who are not involved in it – a little bit negatively sometimes. They worry about the effect of chemicals.

! I mean, there are two really fundamental sciences, and that is chemistry and physics. Because chemistry and physics, those describe everything that happens everywhere, whereas the

! other science fields – like biology and so on – is very, very interesting, and essential to our understanding of life, and our own lives as well.

! But it's not a fundamental understanding of reality as it is with chemistry

chemistry as a career?

✓ MM: I would say it's… it's a very interesting field because it has a lot of existentialism in it, so understanding how everything works is a very challenging but also a very rewarding experience.

New organic reactions keep appearing?

✓ MM: Yes, because the reality is much more complex than we as chemists are able to imagine, and

✓ new things come up all the time, and will forever.

✓ And I think there is no way that we will ever know everything.

✓ And the complexity of organic chemistry, also reflected in complexity of life, is very, very high.

✓ And we are only scratching, you know, the beginning of our understanding of organic chemistry, I think.

Philip H. Dybvig	
Philip H. Dybvig  Economics	Nobel Award News (NaN: Not a number) ✓ My phone had been on 'do not disturb'. ✓ I woke up this morning ✓ And when I woke up I had what seemed like thousands of messages and things. ✓ So I thought something is up. And I figured out pretty soon what it was. AS: When did you know for sure that it was true? ✓ PD: I knew that this was the day, and actually a couple people had suggested I might get it. ✓ I said, no, that won't happen. And, but anyway, I went to nobelprize.org, your website and there it was with Ben and Doug and me. So… AS: Very nice, very nice.. Doing actually then (DAT) ✓ My phone had been on 'do not disturb'. First action/reaction/expression (Far) ✓ I was half asleep and my initial response was probably stress. ✓ What's this gonna do to my life? ✓ But now that it's settled in some, I'm quite happy. AS: Yeah. So you've had a couple of hours to get used to it. What's it done to your life so far? ✓ PD: Well, I just, I have more phone calls and emails and messages than I can possibly respond to… quickly

✓ AS:DD: Douglas Diamond, when we spoke to him, was very eloquent in speaking about your relationship and how much he valued your insight into social sciences and to the clarity of your thought. It was obviously a very special relationship that led to you being able to develop this model.

!

✓ PD: Yeah, Doug is an amazing guy and he's a great co-author. And we worked so hard to make the paper simple, but during the time we were writing it, it could be somewhat intense. It was never unpleasant.

✓ But, you know, one of us would say, "Well, we should assume this." And then the other one would say, "No, that'll be too complicated, we can never solve that." And the other one would say, "Well, how about if we try that?" And then we say, "No, no, that's gonna throw away all the economics," and back and forth.

✓ And I'm hoping that as a result, you know, for economists that, they'll find that to be a

simple paper to read.

- ✓ And I think it paid off some because the model's pretty simple.
- ✓ It's easy to extend, with you know, we've left some room where people can add some things and still solve the model.

Douglas Diamond	
Douglas Diamond  Economics	Nobel Award News (NaN: Not a number) ✓ ✓ I was sound asleep. And my cell phone was right next to me. And the phone rang and I was wondering what it was. ✓ And then I heard a Swedish voice on the line. ✓ I was hoping I wasn't being pranked by one of my friends and it turned out I was not. ✓ And then a couple members, three members of the actual committee spoke to me on the phone and I realized this was indeed the real thing ✓ Doing actually then (DAT) ✓ I was sound asleep ✓ First action/reaction/expression (Fare) ✓ DD speaks about his happiness at receiving the economic sciences prize together with Philip Dybvig and Ben Bernanke

Ben Bernanke	
Ben Bernanke  Economics	Nobel Award News (NaN: Not a number) ✓ No, we were not expecting this to happen. We turned off our cell phones as usual at bedtime. And we got a call from our daughter in Chicago first thing in the morning letting us know that she'd heard a news report. ✓ AS: Have you actually spoken to the committee yet? ✓ BB: I have not. I received the letter in an email and I replied that it was received. ✓ And I apologized for not being available, again. I did not, I was not, you know, considering this possibility, so I didn't, you know, prepare for it. But I acknowledged the letter and thanked the committee for the honour. ✓ And of course, I will do whatever I can to, you know, participate effectively and to enjoy the whole experience. Doing actually then (DAT)

	✓ We turned off our cell phones as usual at bedtime. First action/reaction/expression (Fare) ✓ Yes. I've been pretty calm about it, ✓ but I think I've been trying to process this remarkable development. ✓ So I'll see how I feel in a couple of days, but I'm still trying to take it all in.
	! DD: The world was incredibly lucky to have Ben Bernanke sitting in the Federal Reserve".

Center for Civil Liberties  Peace Oleksandra Romantsova (OR) Executive Director of Center for Civil Liberties	Nobel Award News (NaN: Not a number) ✓ ON: Hello. I am Olav Njølstad, Director of the Norwegian Nobel Institute in Oslo. ✓ Is this Ms. Romantsova? ✓ OR: Yes. ✓ ON: I'm calling you on behalf of the Norwegian Nobel Committee to inform you that in a very few minutes it will be announced here from the Nobel Institute that the Center for Civil Liberties will be awarded the Nobel Peace Prize for 2022 together with another human rights organization and one individual ✓ First action/reaction/expression (Fare) ✓ OR: (laughs) It's… okay. It's… it's (laughs) it's great. Thank you.
OR: Because for us, for your understanding. We have even joined projects explain people Nobel Prize previous years. What exactly, why people accept, the like, was awarded for some prize about peace working. Like for example from 2018 I make a lecture about Nadia Murad and Denis Mukwege and all other. So for us it's really important, like a part of, you know, Ukrainian society culture, to understood what that means, so it's really… thank you.	

SL2: Noble words of Nobel Laureates (2022)

Svante Pääbo influenced by his mother, a chemist

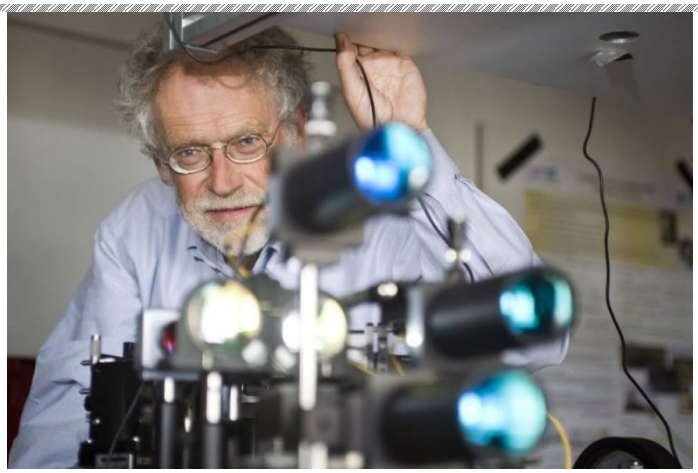
✓ I mean, I think the biggest influence in my life was for sure my mother, with whom I grew up.

And in some sense it makes me a bit sad that she can't experience this day.

- ✓ She sort of was very much into science, and very much stimulated and encouraged me through the years.
- ✓ Having a laureate father taught me an important lesson: "Such people are normal human beings."
- ✓ My father I did have some contact to and he took a big interest in my work, but it was not that close a relationship as with my mother

Med

- ✓ You don't put your parents on a pedestal, at least not when you're a teenager.



Anton Zeilinger, Physicist

Curiosity

- ! You know, life is short, and
- ! Still I'm curious to see
  - o What will happen in the near future, or
  - o In the future as long as I am alive
- ! I don't know how I can follow this anymore

Thanks with gratitude -- Anton Zeilinger

- ! I would emphasise it's also a huge appreciation for the… for all the people who I worked with, you know,

- Starting from my teacher, Helmut Rauch, who started the foundations work in Vienna in late sixties, early seventies, and this was really a curiosity, but it was encouraging for me.

! I also talk of the150 or even more students, who ever worked with me.

! And I appreciate everyone. This was really something.

Nobel words of Anton Zeilinger

! AS: It's very nice thing to say, because of course science is a very social thing, and I imagine that's one of the key reasons that you've spent decades doing this, that it's just such a lovely activity being with all these great people around you.

! AZ: Well, I mean it's lovely to work…

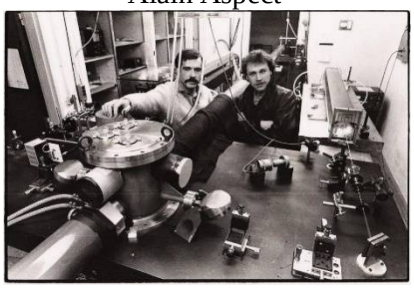
- To see the excitement in the eyes of young people when they realise how interesting things we are working on.

! And for myself it was just, just curiosity. It was always curiosity, and still is curiosity

! And I… you know, I make possible some work on applications in my group, but my interest is always curiosity

Nature- [Reality-Evolution-Space-Time [Rest]]-Nature
Anton Zeilinger, NL-Phys-2022

Alain Aspect



Physics

! Quantum mechanics resists all possible attacks!

! In a sense my experiment was trying to find a limit of quantum mechanics, and

- we didn't find it !!

Message of Annie Ernaux. (NL.Lit) for young writers

Writers in their native language

! AE: I think that when we write

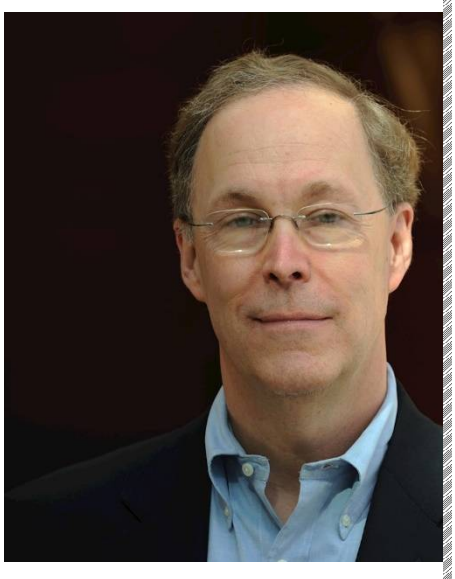
📖 what is really important is that we need to read a lot.

📖 Sometimes young people say, “Oh no, I don’t read… I write!”
📖 Well, no. That’s not possible. You need to read a lot.

! And the second message

☞ I would give them is not to strive to write well,
☞ but rather to write honestly.
☞ It’s not the same thing.

- ✓ Douglas Diamond(DD): we were both (Philip H. Dybvig and Myself) students of Steve Ross at Yale Economics
- ✓ Steve was an amazing advisor and stupendous mentor to both of us.
- ✓ But Steve used to have this policy of not making appointments but you would have to sit outside his door, waiting to see when he had some time to talk.
- ✓ So Phil Dybyig and I sat outside his door, you know, waiting for time to talk to him, and while out there we talked to each other quite a bit.
- ✓ And while we were in graduate school we sort of came up with the idea we wanted to try to work together on something related to these issues. But we didn’t actually start working closely on it until we both had essentially finished our PhDs. And then we basically spent all of our thinking hours in the period we were actually formulating this model together and trying to understand it, and simplify it, we had a more complicated idea in the beginning and we kept simplifying it.



- ✓ And Phil is among the clearest thinkers of anyone I know in social science. So the fact that our model is quite clear and simple would not be possible without him as a co-author.

AS: That’s absolutely fascinating.

- ✓ I imagine listening to this the world over now will adopt that approach of having students wait outside the door. And talking to each other, it was obviously tremendously successful.

- ✓ DD: Yes, and he had an assistant who was very nice and gave us cookies and things like that while we sat out there too. So that was also very helpful. No one starved outside of Steve Ross’s door.

AS: Combination of cookies and patience. Worked wonders. Gosh, it’s been an enormous pleasure speaking with you.

Carolyn Bertozzi ; Chemistry

- !
- ! "Nobel prizes shines a spotlight on a field"
- ! You know, Barry Sharpless's work has been, you know, kind of mesmerising me since I was a graduate student. You know, and I heard him speak at Berkeley back in… somewhere in the late 1980s or early '90s, and you know,
- ! and Morten Meldal's work I studied while I was in graduate school because he did a lot of work on glycopeptide synthesis, before, you know, his epic publication of click chemistry.
- ! So these are people that I've learnt… been learning from for many years. Decades even

Inspiration

- ! I've had family members and close friends who've suffered from ailments that were so untreatable, you know.
- ! So, you know, it was always my hope that as a scientist, you know, I could make some contributions that might benefit human health,
  - o Either in the near term or the long term, but you know, that was always my goal.
  - o Or not even necessarily in my lifetime,
- ! And I like teaching, and you know,
  - o Like working with people who share my passion, and
  - o Who I can, you know, help with the wisdom of my age, I guess.

- ! Chemistry is the central science, as we call it.
- ! And, you know, it's such an exciting area of science for people who want to have an impact in biology and medicine and materials and climate and sustainability, right? Chemistry is so central to all of it.
- ! Really, it's, you know, when the world is in trouble, chemistry comes to the rescue, right.
- !
- ! And covid-19 is a great example of that. So I think, you know, maybe, maybe I can contribute to, you know, making our public image more exciting and positive, you know