GEN PHILIC

Department of Biotechnology,
Fergusson College (Autonomous),
Pune.

Issue 8 | 09-03-21

Contributions of Nobel Laureates to Science

Dr. Sonali Joshi
Head of the Department Biotechnology

Dr. Gayatri Gurjar
Editor-in-Chief

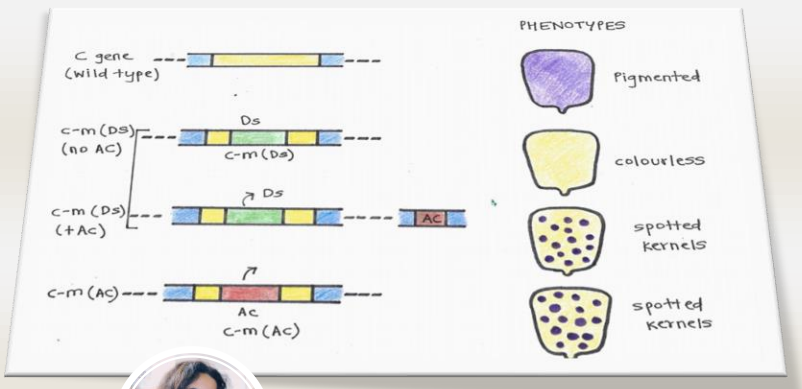
A Hip, A Hop and Jump!

The Nobel Prize in Physiology or Medicine 1983 Barbara McClintock for her discovery of "mobile genetic elements".

Article by
Surabhi Verma
F. Y. BSc. Biotechnology

Many in the 20th century believed that genes were immobile entities that were coherently arranged in a linear pattern on chromosomes, like beads on a string. That was until Barbara McClintock discovered 'Jumping Genes' AKA transposons. These led to genetic instability which was first observed in maize, which led to altered pattern of pigmentation in the kernels 'phenotype.

McClintock found that the variegated colour pattern of maize kernels was caused due to transposition of structural elements within or between chromosomes. Through this experiment, she discovered the site of chromosome breakage and called it "dissociation" (Ds). She also found out that the movements of Ds are regulated by an autonomous element called "activator" (Ac). She termed these transposable genetic bits as "controlling elements". Though control elements behave as ordinary genes in genetic crosses they cause inactivation of neighbouring genes when they transpose along or between chromosomes and when control elements leave a certain region, the previously inactivated genes resume normal functions. Barbara McClintock said, *"From examination of instability of genic action at a number of known loci in maize, it is concluded that mutations need not express changes in genes but may be the result of changes affecting the control of genic action".*



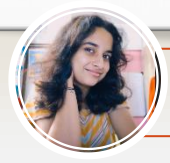


Illustration by: Aarya Kuvalekar
F. Y. BSc. Biotechnology

Such elements were also discovered in unicellular parasites such as trypanosomes. They imparted them the ability to change their surface properties and as such, avoid host immune response. As per evidence, genes controlling cell growth can undergo translocation during transition of normal cells to cancerous cells.

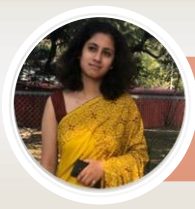
Although McClintock's observation of the behaviour of kernel colour alleles was not widely accepted at the time of its discovery, it was revolutionary in its proposition that genomic replication does not always follow a consistent pattern. After a long period of relative neglect, she was awarded the Nobel Prize in 1983 for her work on genetic instability. Barbara McClintock's life shows us how important it is to nurture original and unconventional thinking in science if we are to get out of the rut of ordinariness.

Long Live the Nerve!

The Nobel Prize for Physiology or Medicine in 1986 for the discovery of growth factors – Nerve growth factor (NGF) and Epidermal growth factor (EGF).

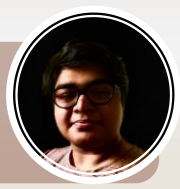
In 1986, Rita-Lev-Montalcini and Stanley Cohen were awarded the Nobel prize for their discovery of growth factors – Nerve growth factor (NGF) and Epidermal growth factor (EGF). Over the years many more growth factors have been discovered and extensive research has been carried out on them. This discovery gave us a completely new perspective of looking at the different processes in a cell's life cycle. These growth factors are said to have influence on not only cell proliferation but also cell differentiation and cell death i.e., apoptosis. Basically, these proteins work as signalling molecules or cytokines because of their heat-labile, non-dialyzable, protease sensitive and DNA-ase and RNA-ase insensitive nature.

I have always wondered what made the nerve cells live so long? Apparently one of the reasons behind their long life is NGF(Nerve growth Factor),a



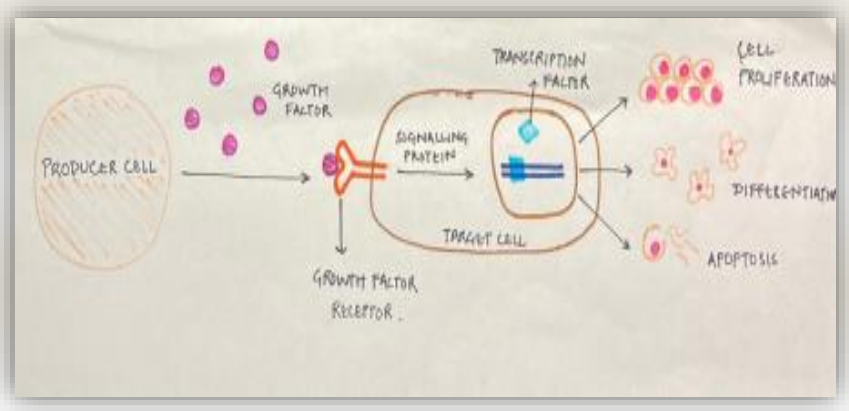
Mudra Deshpande
S.Y.BSc.Biotechnology
(Editor)

Shreyas Joshi
S.Y.BSc.Biotechnology
(Layout Designer)



Divya
S.Y.BSc.Biotechnology
(Editor)

neuropeptide primarily involved in generation of growth, maintenance, proliferation and survival of target cells. They are also said to be responsible for the negative regulation of neuron apoptotic process. It was first found by Rita-Lev-Montalcini in extract of tumour of a chick embryo which also opens the possibility of it playing an important role in tumour development. At the same time another growth factor i.e., EGF was also found. Similar to NGF, this protein also influenced the growth of a cell and had a high affinity for a particular receptor, now known as EGFR; later on, this protein was classified as an important growth factor, the Epidermal Growth Factor.



Overall, this amazing breakthrough in the World of science in year 1986 has helped us in increasing our understanding of a number of life-threatening diseases as well as observing our body processes with a completely new approach. Last but not the least, I have always believed that biology is full

of surprises and that its study would help us in developing a better tomorrow.

Article and Illustration by
Anushka Thatte
F.Y.BSc.Biotechnology

RNA Knocks the Door.

The Nobel Prize in Chemistry in 1989 for the discovery of Ribozyme.

Article by
Diksha Bhagat
S. Y. BSc. Biotechnology

We all have heard the saying - All enzymes are proteins, but not all proteins are enzymes!!

However, have you ever wondered that there might be some enzymes that are not proteins?? Well, in early 1980s, research groups led by Thomas Cech and Sidney Altman discovered an enzyme which was non-proteinous in nature and later came to be coined the term — RIBOZYME — one can guess from the name that it is a Ribonucleic acid enzyme.

Thomas Cech, who was born on 8th December 1947 in Chicago, USA is an American Chemist and Sidney Altman who was born on the 7th of May, 1939 in Montreal is a Canadian-American molecular biologist. They both shared the Nobel Prize in Chemistry in 1989 for the discovery of Ribozyme.

At the University of Colorado at Boulder, Cech was studying how RNA molecules split into fragments to make a mature and functional RNA, in a unicellular organism called as *Tetrahymena thermophilia*. He transferred an unprocessed RNA molecule of the organism into a test tube, and didn't add any protein. Surprisingly, he discovered that even in the absence of protein, the RNA molecule was able to splice and join the genetically important fragments itself.

I was never interested in RNA. I knew very little about it, all of my research was directed towards understanding chromosomes, DNA, genes - said Thomas Cech during one of his interviews discussing his Nobel Prize winning discovery.

Cech and his team started the research with the expectation that the catalyst would be a proteinaceous enzyme, who they suspected must be doing the work of splicing in the test tube. They started off with such an assumption due to the fact that the extract they took was very crude. Their research was aimed towards proving hypothesis that this splicing protein must be tightly associated with the RNA itself, however this hypothesis was not supportive. They went on doing many experiments and in due course of time put forward another hypothesis, proposing that perhaps there is no protein associated with the RNA.

Cech was working on a reaction in which RNA performed the role of a self- catalyst. Later onwards, Sidney Altman, who was working separately in Yale University, started unearthing other catalytic activity of RNA. He worked on an enzyme called the Ribonuclease-P (named as such as it has both RNA and protein component) and found that ribonuclease-P can splice and transfer RNA molecule. Seeing as they both reached the same conclusion of RNA also having the ability to act as a catalyst, they both had shared the Nobel Prize.

RNA really came looking after us, more than we came looking for RNA – **Thomas Cech**.

Ribozyme is considered one of the strongest evidences which supports RNA world. This discovery of RNA as a biocatalyst is useful in gene technology as well. Ribozyme discovery has also altered Central Dogma, by giving it exceptions. These ribozymes have also found a niche for themselves in the medical sector since they can also be engineered and then employed to destroy RNA molecules which give rise to harmful effects in humans.

The GPS Tracker!

The Nobel Prize for Physiology or Medicine in 1999 for his discovery of signal sequence.

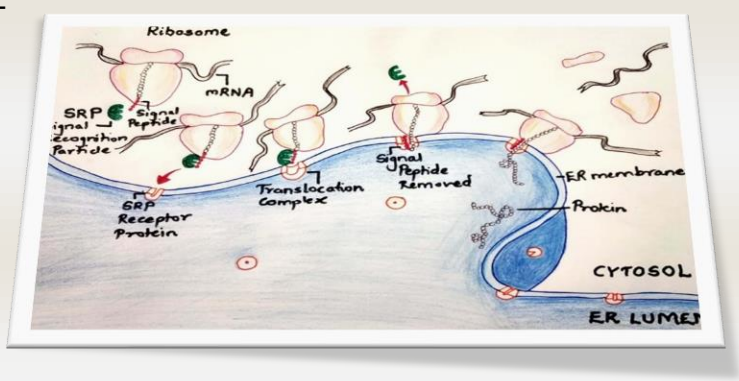
Article and Illustration by
Parag Palod
F. Y. MSc. Biotechnology

Have you ever wondered how are molecules directed to various organelles? What makes them land in the correct location in the cell and not any other organelle? The answer for this was given by Gunter Blobel.

Gunter Blobel was a German-born American cellular and molecular biologist who discovered that proteins have signals that govern their movement and position in the cell. He was awarded the Nobel Prize for Physiology or Medicine in 1999 for his discovery of signal sequence.

By 1980 Blobel had established the general principles underlying the mechanism by which proteins are targeted to specific organelles within a cell. Working in collaboration with other research groups, he conducted a series of experiments showing that each protein carries an address code within its molecular structure, a signal sequence that directs it to the proper locale inside the cell. The address code, which consists of a sequence

of amino acids, specifies whether the protein will pass through the membrane of a specific organelle, become integrated into the membrane, or be exported out of the cell. Blobel also concluded that proteins enter organelles through a pore-like channel that opens in the organelle's outer membrane when the correct protein arrives at the organelle.



Blobel's later research focused specifically on a pore-like channel in the nuclear envelope (the membrane surrounding the cell nucleus). This channel came to be known as the nuclear pore complex (NPC). The NPC is one of the largest protein-based components found in cells, made up of proteins which he named as nucleoporins and provides the main method of transport for proteins between the cytoplasm and the nucleus. His team also identified and described several NPC transport factors that recognize the signal sequences in proteins and enable the passage of these proteins into the nucleus.

So, it was his work which gave us a better understanding of protein transportation and the structure of nucleus. He will always be remembered as a pioneer of molecular cell biology.

Being Nosy is Beneficial?

The Nobel Prize for Physiology or Medicine in 2004 for the discovery of odorant receptors and the organization of the olfactory system'

I'm sure all of you have wondered what dogs have but we don't? Technically speaking, a lot of things but one very important thing about them is that, they possess up to 300 million olfactory receptors in their noses, compared to about 6 million in us. A dog's brain is devoted to identifying smells, 40 times greater than ours. So, our furry friend is more evolved when it comes to the olfactory system and its receptors mainly because some of the human olfactory genes were lost during evolution. Want to know more about the human olfactory system? We got you covered.

The 2004 Nobel Prize in Physiology or Medicine was awarded jointly to Richard Axel, an HHMI investigator at Columbia University's College of Physicians and Surgeons, New York and Linda Buck, an HHMI investigator at the Fred Hutchinson Cancer Research Centre, Seattle. The scientists were honoured for their discoveries of the odorant receptors and the organization of the olfactory system. We were all aware of the fact that humans can recognise and remember about 10,000 different odours but the basic principles weren't understood properly. 2004's laureates solved this problem in a series of investigative studies and clarified how our olfactory system works.

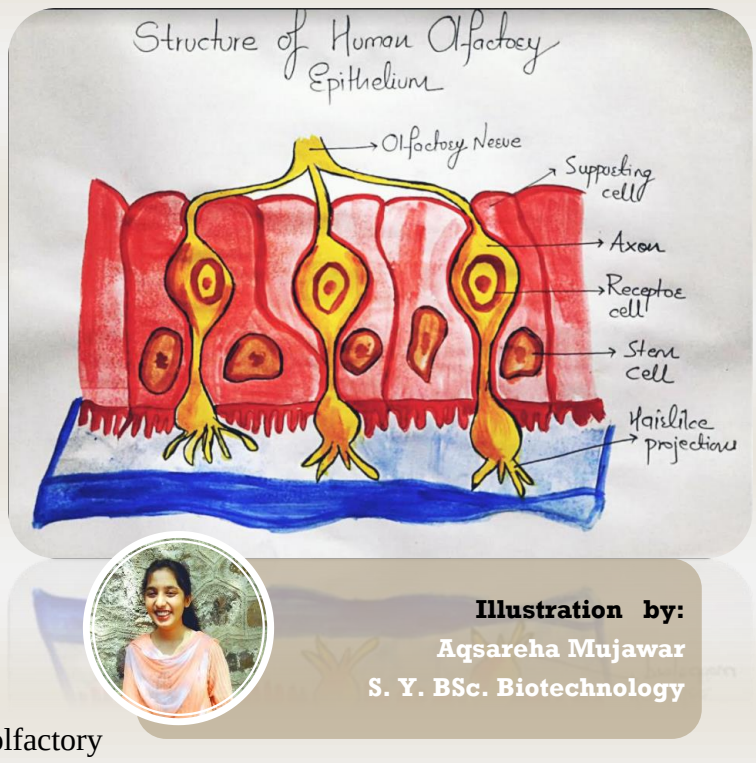


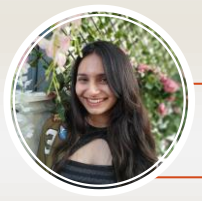
Illustration by:
Aqsareha Mujawar
S. Y. BSc. Biotechnology

Axel and Buck published the paper jointly in 1991, describing their discovery of a large gene family comprising of around 1,000 genes which gives rise to about the same number of different types of olfactory receptors. These receptors found in the olfactory receptor cells, are located in the upper part of nasal epithelium and play a major role in detection of inhaled odorant molecules. Each olfactory receptor cell expresses only one of the odorant receptor genes hence, these receptor cells are highly specialised. Most odours are composed of multiple odorant molecules, and each odorant molecule activates several odorant receptors. This leads to a combinatorial code forming an "odorant pattern" and that is the basis for our ability to recognize and form memories of almost 10,000 different odours.

How does an olfactory receptor work? An olfactory receptor is activated by an odorous substance and this triggers an olfactory receptor cell in the nasal epithelium that sends electrical signals to the brain. The cells send thin nerve processes directly to distinct microdomains, glomeruli, in the olfactory bulb which is the primary olfactory area of the brain. The odorant receptor is coupled to a G-protein and activates it which in turn, stimulates the formation of cyclic AMP. The cAMP activates and opens ion channels thereby activating olfactory receptor cells. It was also proved that this large family of olfactory receptors belong to the family of GPCRs (G-protein coupled receptors).

Since the olfactory system is one of our primary sensory systems, no wonder that almost 3% of our genes code for these olfactory receptors. Olfaction is of central importance for most species and the olfactory system is also important for life quality. All living organisms can detect and identify chemical substances in their environment. To lose the sense of smell is a serious handicap – we will no longer perceive the different qualities of food, detect warning signals, for example smoke from a fire and to have it, a blessing.

Article by
Pragyananda Choudhury
S. Y. BSc. Biotechnology

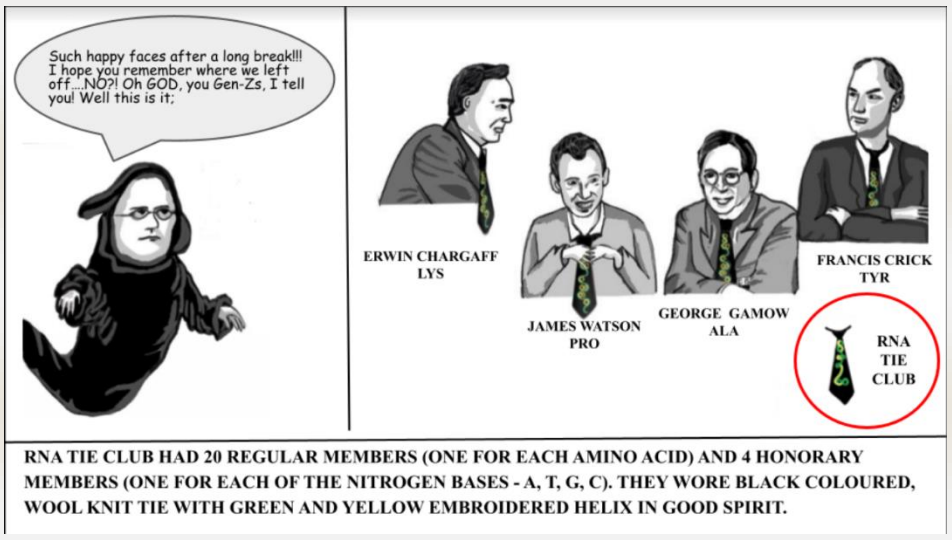


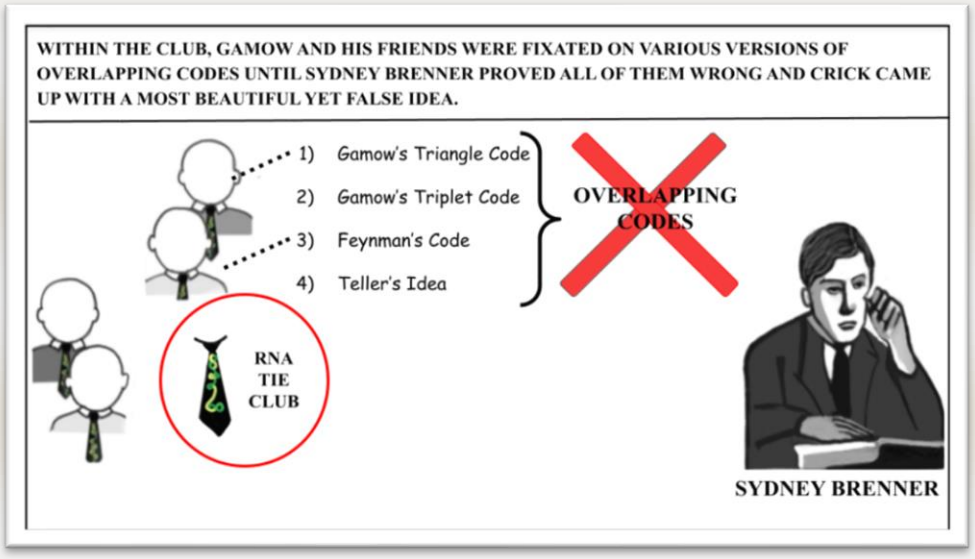
And Sifa Lalani
S. Y. BSc. Biotechnology

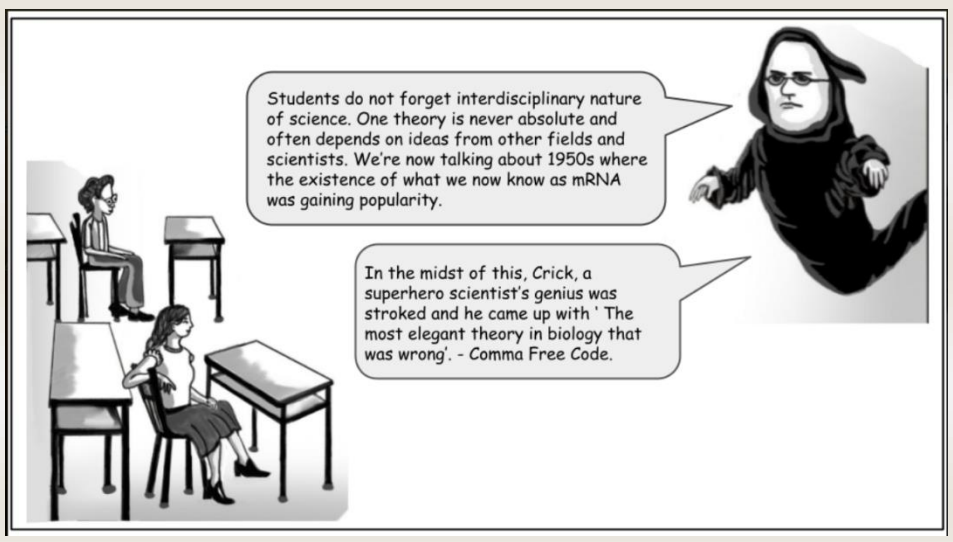
Back to Basics with Friendly Grandpa Ghost Mendel!

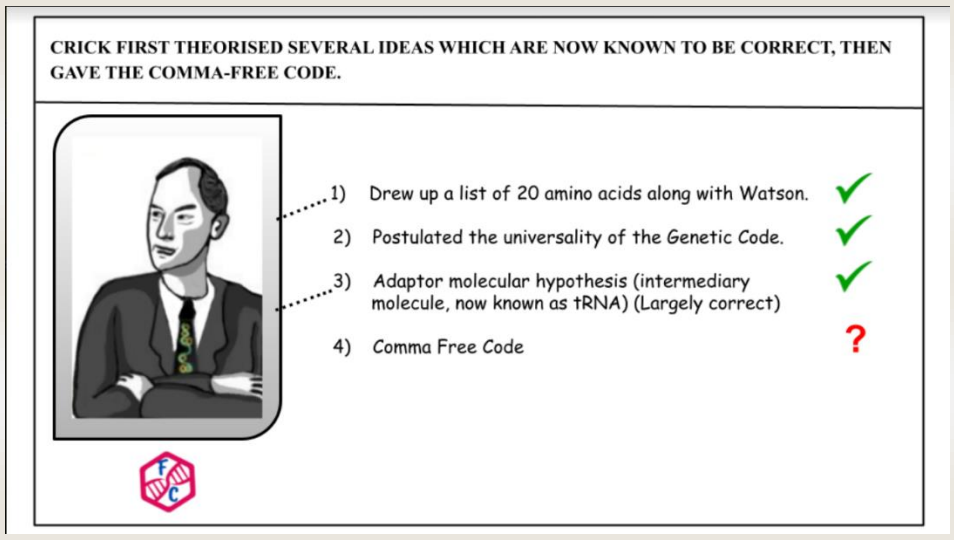
You know the legendary Gregor Mendel. You might not know the legends in the race to find messengers of life! Come, discover the story with Mendel himself, and see where the journey takes you!

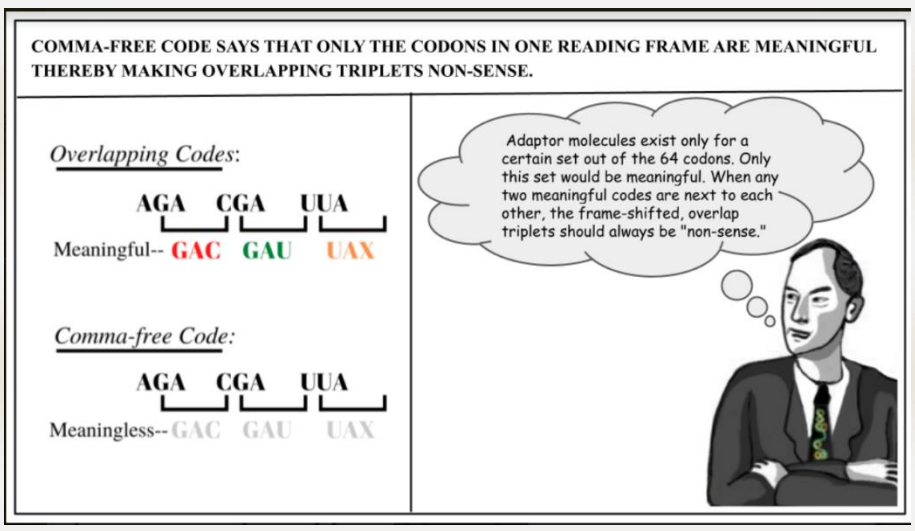
(Note: Read Left to Right)

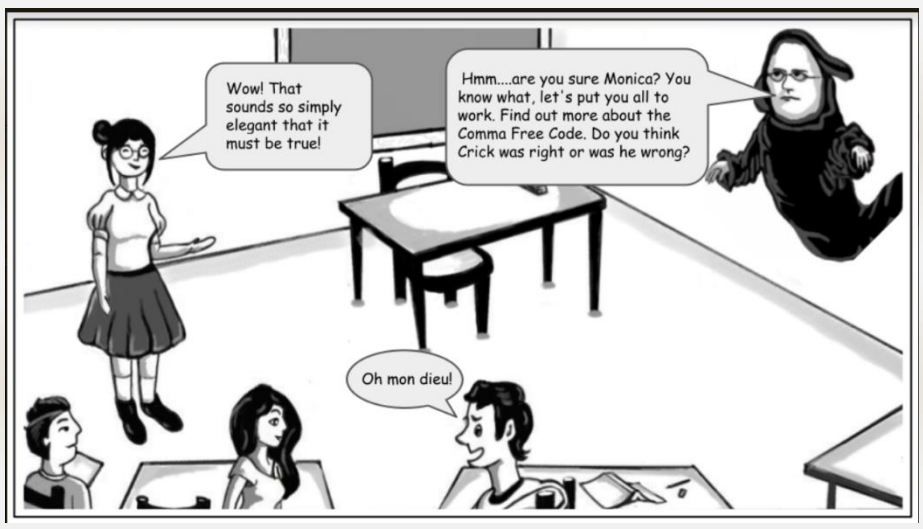






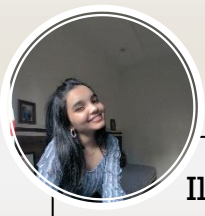







Author:Aarjvi Jain
S.Y.BSc.Biotechnology


Co-Author:Shravani More
F.Y.BSc.Biotechnology


Illustrator:Samidha Dabrase
F.Y.BSc.Biotechnology

The Merry Game-te Corner

Created by Divya Bhardwaj
S. Y. BSc. Biotechnology

Code Decode

Fill in the blanks and unjumble the highlighted letters to decode the word of this issue.

I. The cell's internal spa is called: _ _ _ _ _ _ _ _
II. McClintock used these to decipher jumping genes: _ _ _ _ _ _
III. Thomas Cech worked on: _ _ _ _ _ _ _ _
IV. Telomere function is related to: _ _ _ _ _

Word of the Issue: _ _ _ _ _ _ _ _

Heredity Hunt

Find the words listed in the word search below:

Let the Hunt Begin!

Find Us:

TELOMERE
LAUREATE
NPC
RIBOSOME
OLFACTORY
MOBILE
SPLIT
NOBEL
AUTOPHAGY
NERVE

A	B	Q	Y	O	N	H	A	S	E	V	R	O	K	G
Y	S	L	R	R	M	Y	V	U	D	P	K	P	L	Z
A	H	M	O	B	I	L	E	S	E	A	N	I	S	Q
G	B	T	T	I	A	I	W	I	M	N	O	W	A	E
J	E	H	C	E	N	J	L	K	O	D	B	D	U	J
O	A	Z	A	R	L	W	K	E	S	P	L	I	T	N
E	P	O	F	L	A	O	D	V	O	E	E	J	O	Z
D	O	E	L	H	U	L	M	R	B	Y	W	R	P	R
B	H	G	O	T	R	E	A	E	I	M	G	W	H	I
K	D	H	K	I	E	F	U	N	R	U	M	L	A	J
C	S	K	J	J	A	N	P	D	H	E	A	Q	G	S
Q	P	A	D	O	T	X	Q	H	T	R	I	A	Y	T
H	I	N	S	L	E	L	P	A	R	A	K	D	B	H

Gags by Gregor

Q. Why did the scarecrow get a Nobel Prize?

A. Because he was out-standing in his field.

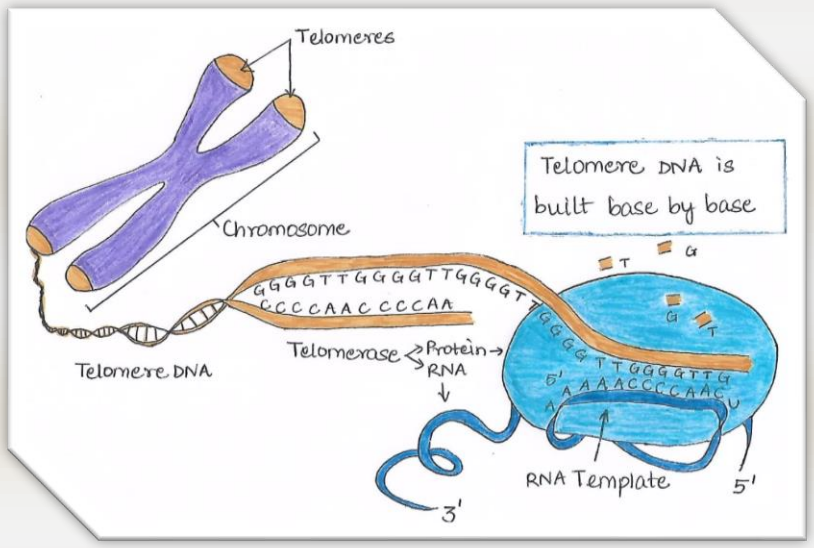
Blackburn's Magic

The Nobel Prize for Physiology or Medicine in 2009 for the discovery of telomeres and telomerase

Article and Illustration by
Sneha Phadke
F.Y. BSc. Biotechnology

Elizabeth Blackburn first studied telomeres in 1975 in the ciliated protozoan, *Tetrahymena thermophila*. Telomeres? Telomeres are regions of DNA sequences at the ends of chromosomes that stabilize them during replication and prevent them from fusion during cell division.

It was a convenient model since it had many short, linear chromosomes called "minichromosomes". She found that a specific DNA sequence (TTGGGG) was tandemly repeated at the telomeres of each chromosome. Similar observations were made by Jack Szostak in yeast, but with irregular repeats.



In the 1980s, Szostak and Blackburn showed that Tetrahymena repeat sequences added to artificial minichromosomes protected them from degradation in yeast cells. This signified that the sequences were responsible for the protective activity of telomeres and were evolutionarily conserved in eukaryotes.

The next step was to identify an enzyme catalysing telomere extension – a telomerase. In 1985, Blackburn and her doctoral student, Carol Greider, isolated telomerase from Tetrahymena cell extracts and created a synthetic telomerase gene. This gene was re-introduced into Tetrahymena cells to establish the function of telomerase.

It was found to be a reverse transcriptase consisting of a protein and a telomerase mRNA, which acts as a template to synthesise telomeric DNA. As expected, a mutation resulting in a non-functional enzyme caused telomere shortening and stopped cell division.

The Nobel Prize in Physiology or Medicine is awarded by the Nobel Assembly at Karolinska Institute every year. The 2009 laureates were Elizabeth Blackburn, Carol Greider and Jack Szostak, for their discovery of how chromosomes inside a cell are protected by telomeres and the enzyme telomerase.

Telomeres and telomerase are significant areas of research into cancer and ageing in humans. The high telomerase activity of cancer cells may be exploited to induce apoptosis by inhibiting telomerase or synthesising non-functional telomeres. Telomere length changes with age and environmental influence, with decreased length linked to increased risk of age-related diseases.

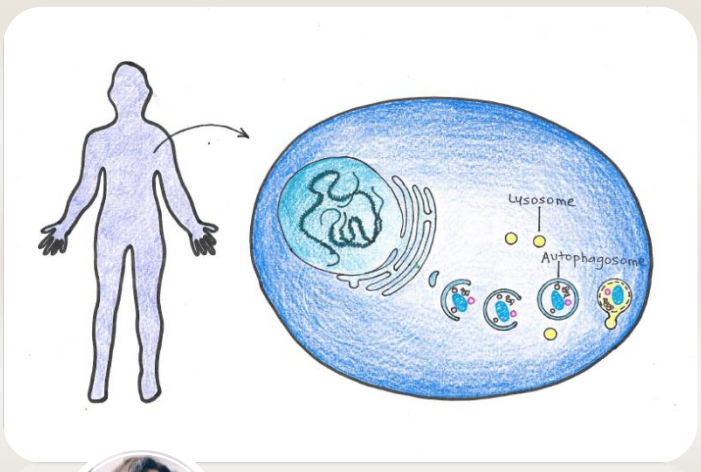
This Nobel-winning research has helped us understand the fundamental processes behind the maintenance of chromosomes (and therefore genetic material). It has also helped to identify possible underlying mechanisms of genetic and age-related diseases, and given rise to potential treatments.

The Recycle Bin – Autophagy

The 2016 Nobel Prize in Physiology or Medicine, Yoshinori Ohsumi, for his discoveries of mechanisms for autophagy.

Article by
Shreyas Joshi
S. Y. BSc. Biotechnology

Did you know that the diseases, right from Parkinson's, Alzheimer's, Diabetes all the way to Cancer, have been linked to the disruption of a process? If the name 'Autophagy' came into your mind, then you've nailed it! It is Autophagy. The word autophagy (pronounced o-toff-a-gee) has been derived from the Greek expression of self-eating.



Dysfunction in autophagy is life-threatening from birth to old age. We can think of autophagy as a cell's internal spa. Cells use autophagy for self-renewal, which gives them a new lease of life and allows them to combat invaders during tough times. Baker's yeast was used as a model to identify genes essential for autophagy. The statement put forth was, due to the size of yeast cells (being small) the internal structure was not easily visible nor distinguished under the microscope. Therefore, there was uncertainty regarding the idea of whether autophagy existed in the organism.

We often tend to think that if our cells are starved, they immediately shut down but, they don't instead, they employ autophagy to cannibalize their components to release energy and to build new functional parts. The stress-induced in the yeast cells upon starvation led to the creation of relatively huge spherical trash cans - now known as autophagosomes.

Illustration by:
Aarya Kuvalekar
F. Y. BSc. Biotechnology

A clever way used to identify these autophagosomes was via the starved cells, as starved cells are unable to degrade the content of vacuole. This further led to the study of genes associated with autophagy via the yeast cells' mutants. Further study deepened our understanding related to the product of the genes associated with autophagy.

These discoveries led to a new paradigm in our understanding of how the cell recycles its content. The man behind this paradigm-shifting research is Yoshinori Ohsumi. Genetic studies in various fungi, particularly Saccharomyces cerevisiae, led to a breakthrough in the field of research on the basic mechanisms and physiological connections concerning autophagy. The Nobel Committee has recognized this breakthrough by awarding the Nobel Prize in Physiology or Medicine for research in autophagy in 2016. Yoshinori Ohsumi also believes that we have even more questions than before as we pave our way to understanding the process.

How did you find it? Any feedback? Suggestions?

Hey guys! We are back with a bang and it's great to see you again!

We would love to know what you thought of this issue of Genophilic, any suggestions are most welcome.

As we have expanded our horizons, our next issue will be on the topic "Viruses **and vaccines**"; starting with latest viral diseases and their vaccines going down the timeline.

We would appreciate your contributions on said topic.

Contact us on: editor.genophilic@gmail.com

References for Articles:

The Nobel Prize in Physiology or Medicine 1983 Barbara McClintock for her discovery of "mobile genetic elements".

1. https://www.nobelprize.org/prizes/medicine/1983/press-release/
2. https://www.pnas.org/content/
3. 109/50/20198#:~:text=In%20the%20late%201940s%2C%20Barbara,some%20genes%20could%20be%20mobile.&text=She%20also%20found%20that%20depending,the%20 expression%20of%20other%20genes.
4. https://www.nature.com/scitable/topicpage/barbara-mcclintock-and-the-discovery-of jumping-34083/
5. https://www.cshl.edu/one-experiment-mcclintocks-historic-discovery/

The Nobel Prize for Physiology or Medicine in 1986 for the discovery of growth factors – Nerve growth factor (NGF) and Epidermal growth factor (EGF).

1. Wikipedia
2. Sinobiological.com
3. Translational-medicine.biomedcentral.com
4. Ncbi.nlm.nih.gov

The Nobel Prize in Chemistry in 1989 for the discovery of Ribozyme.

1. https://www.youtube.com/watch?v=HwEgcH1zsXw
2. https://www.news-medical.net/life-sciences/Ribozyme-Discovery.aspx
3. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3498233/
4. https://www.nobelprize.org/prizes/chemistry/1989/press-release/

The Nobel Prize for Physiology or Medicine in 1999 for his discovery of signal sequence.

1. "Günter Blobel: Pioneer of molecular cell biology (1936–2018)" - An article in Journal of cell Biology
2. Günter Blobel – Author Manuscript at HHS (Department of health and human services - USA)
3. Gunter Blobel - www.britannica.com
4. Bound ER Ribosomes infographic lifted from www.bio.utexas.edu article Gene to Protein.

The Nobel Prize for Physiology or Medicine in 2004 for the discovery of odorant receptors and the organization of the olfactory system'

1. "The Nobel Prize in Physiology or Medicine 2004." NobelPrize.org, www.nobelprize.org/prizes/medicine/2004/press-release/.
2. "Richard Axel and Linda Buck Awarded 2004 Nobel Prize in Physiology or Medicine." HHMI.org, www.hhmi.org/news/richard-axel-and-linda-buck-awarded- 2004-nobel-prize-physiology-or-medicine.

3. A Nobel Nose: The 2004 Nobel Prize Essay in Physiology and Medicine, Stuart Firestein, Neuron, Vol. 45, 333–338, February 3, 2005, DOI10.1016/j.neuron.2005.01.021, https://www.cell.com/neuron/pdf/S0896-6273(05)00053-X.pdf

The Nobel Prize for Physiology or Medicine in 2009 for the discovery of telomeres and telomerase

1. https://www.nobelprize.org/prizes/medicine/2009/summary/
2. Nobel Lecture by Elizabeth H. Blackburn (nobelprize.org)

The 2016 Nobel Prize in Physiology or Medicine, Yoshinori Ohsumi, for his discoveries of mechanisms for autophagy.

1. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5240711/
2. https://www.nature.com/collections/fmvcnfkvjn

References for Illustrations:

The Nobel Prize in Physiology or Medicine 1983 Barbara McClintock for her discovery of "mobile genetic elements".

- http://www.bio.miami.edu/dana/250/250SS13_17.html

The Nobel Prize for Physiology or Medicine in 1986 for the discovery of growth factors – Nerve growth factor (NGF) and Epidermal growth factor (EGF)

- *usbio.net*
- *Applied biological material*

The Nobel Prize for Physiology or Medicine in 1999 for his discovery of signal sequence

- http://www.bio.utexas.edu/

The Nobel Prize for Physiology or Medicine in 2004 for the discovery of odorant receptors and the organization of the olfactory system'

- *https://www.d.umn.edu/~jfitzake/Lectures/DMED/SensoryPhysiology/Olfaction/OlfactoryEpithelia.html*

The Nobel Prize for Physiology or Medicine in 2009 for the discovery of telomeres and telomerase

- *Illustrated Presentation. NobelPrize.org. Nobel Media AB 2021. Tue. 2 Mar 2021. https://www.nobelprize.org/prizes/medicine/2009/illustrated-information/*

The 2016 Nobel Prize in Physiology or Medicine, Yoshinori Ohsumi, for his discoveries of mechanisms for autophagy

- *https://www.nobelprize.org/prizes/medicine/2016/press-release/*

References

Back to Basics with Friendly Grandpa Ghost Mendel!

- *https://www.ias.ac.in/article/fulltext/reso/009/07/0044-0049*
- *http://bit-player.org/wp-content/extras/bph-publications/AmSci-1998-01-Hayes-genetic-code.pdf*