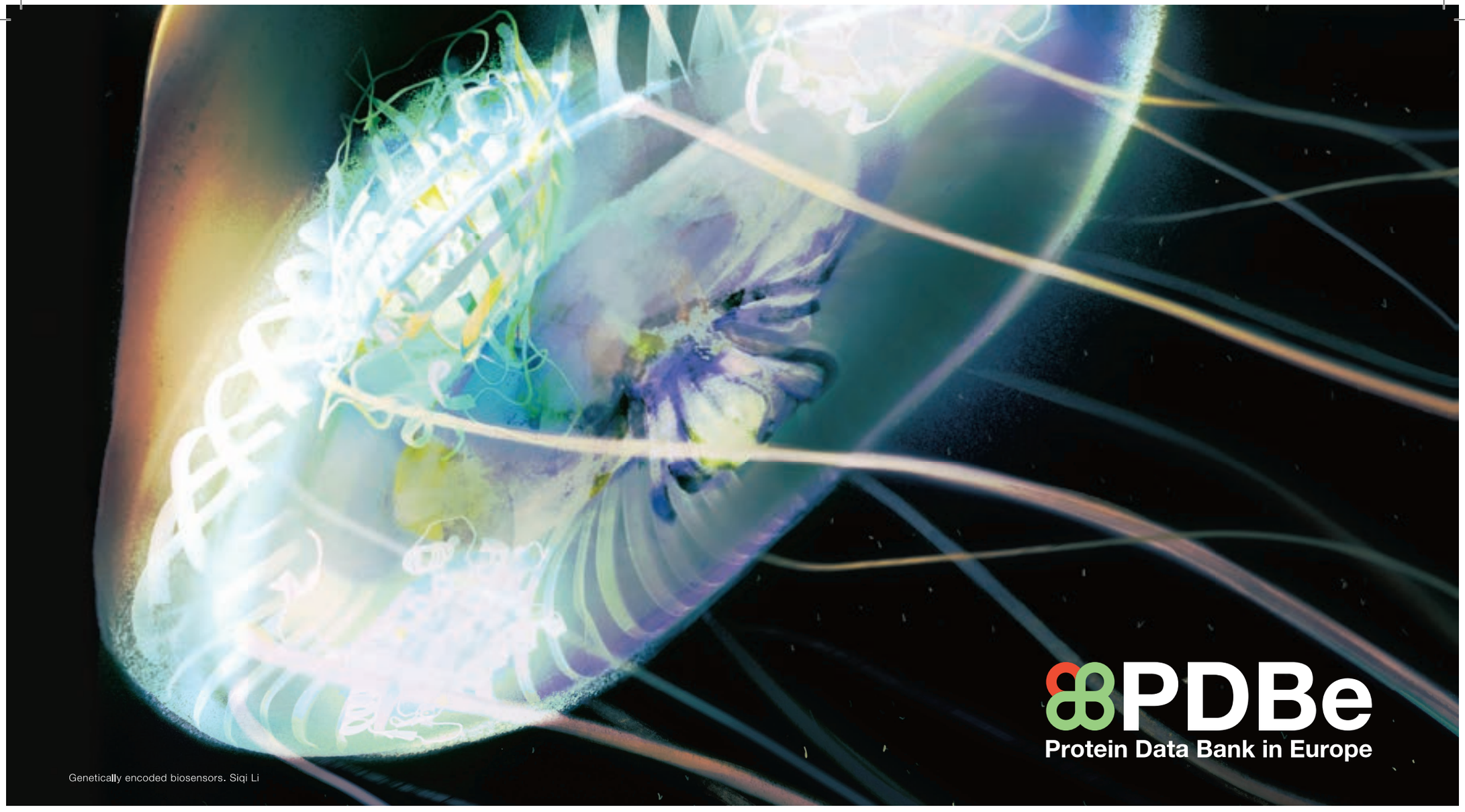

Genetically encoded biosensors. Siqi Li

2023 CALENDAR

Visualising the World of Protein


JANUARY

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PDBe
Protein Data Bank in Europe

Flipping a protein light switch

Fluorescent proteins are molecules that absorb radiation and emit light, making the organism look like it's glowing. These proteins are found naturally in a number of organisms, such as jellyfish, coral, and sea anemones. Their specific absorption and emission profiles can vary, producing a range of different colours. Some fluorescent proteins are photoswitchable, meaning the organisms can turn the fluorescence on and off, like operating a light switch.

In this artwork, Isaac has represented the structure of a green fluorescent protein using laser-cut paper, curled and arranged to portray the protein structure. The striking colours highlight the unexpected and vivid range of colourful fluorescence generated by these proteins.

Paper curl
Isaac Noblet

PDBe.org/2a53/3d

FEBRUARY

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PDBe
Protein Data Bank in Europe

Snowdrops

Snowdrops are among the earliest signs that spring is on its way. They transform woodlands and gardens into impressive carpets of white flowers, and provide vital nectar for bees and wildlife. Lectin proteins from snowdrops exhibit insecticidal effects and provide resistance against pests. Genes encoding snowdrop lectins are therefore used in transgenic plants to protect crops from pests, to serve as plants' natural defence mechanism.

Beatrice explored the topic of germination in plants and nature as part of her project and found inspiration in this lectin protein structure found in snowdrops. Incorporating the appearance of a snowdrop and mimicking the colours, she used blue and green inks for the etch to keep the connection between the artwork and nature.

Embroidery with etching
Beatrice Gibbons

PDBe.org/1niv/3d


MARCH

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PDBe
Protein Data Bank in Europe

Light of the fireflies

The glow of fireflies in the night sky has long been a source of wonder, with some ancient civilisations considering it to be a gift from the gods. The light generated by fireflies is an example of bioluminescence: light is emitted following a chemical reaction between oxygen and an organic substance called luciferin. The reaction occurs with the help of an enzyme luciferase, and adenosine triphosphate.

Yasmin found inspiration in the uniqueness of fireflies and how they generate light. She experimented with composition in the artwork, using mixed media to create her final piece.

Lino printing with mixed media
Yasmin Martin

PDBe.org/1lci/3d


APRIL

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PDBe
Protein Data Bank in Europe

Weapons from the sea

Conotoxins are short, neurotoxic peptides found in the venom of predatory marine cone snails. They paralyse and kill their prey by blocking or inhibiting the victim's nervous system. Cone snail venom comprises a rich and diverse cocktail of peptide toxins. Around 700 species of cone snails live in the world's oceans and each venom contains a mix of about 200 peptides. So far, more than 10,000 conotoxin sequences have been discovered. Despite being deadly to humans, several conotoxins have been identified as potential pain-relieving drugs.

Hayley loves challenges. When she first saw the intricate structures of conotoxins, she was keen to integrate them into her artwork. She used shading techniques with ink and bleach to make the shells appear more realistic.

Drawing
Hayley Yuen

PDBe.org/1qmw/3d


LUCIFERASE
MAY

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Glowing fishing rod

Many bioluminescent organisms live in the darkest of places on Earth. They are often the only source of light in their environment. The angler fish depicted in this artwork have mastered a trick to light up the depths of ocean floors and are renowned for their light-emitting 'fishing-rod'. The source of their bioluminescence are the symbiotic bacteria associated with the fish. This creation of light in complete darkness is generated by the reaction of luciferin and oxygen in the presence of the enzyme luciferase.

Oscar's artwork is inspired by the graphic artist M.C. Escher whose art explores topics such as perspective and symmetry.

Drawing
Oscar Higham

PDBe.org/2psd/3d


JUNE

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Protein Data Bank in Europe

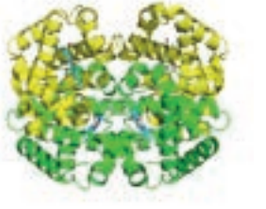
The colour of blood

What gives our blood its deep red colour? We have around 5 million red blood cells per microlitre of blood, and each cell contains around 300 million haemoglobin protein molecules. Each haemoglobin molecule contains four copies of a pigment called heme, an iron-containing molecule that binds to a single molecule of oxygen in order to transport it around the body. The molecular structure of the heme molecule allows the absorption of light in the blue and green regions of the visible spectrum, therefore reflecting only red light and giving blood its characteristic colour.

Luke used the contrast of different shades of red in his artwork to create the haemoglobin structure, while alluding to the molecule's presence in blood.

Print
Luke Hogan

PDBe.org/2hhb/3d




JULY

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PDBe
Protein Data Bank in Europe

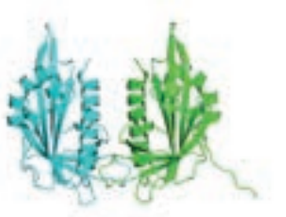
Water conservation

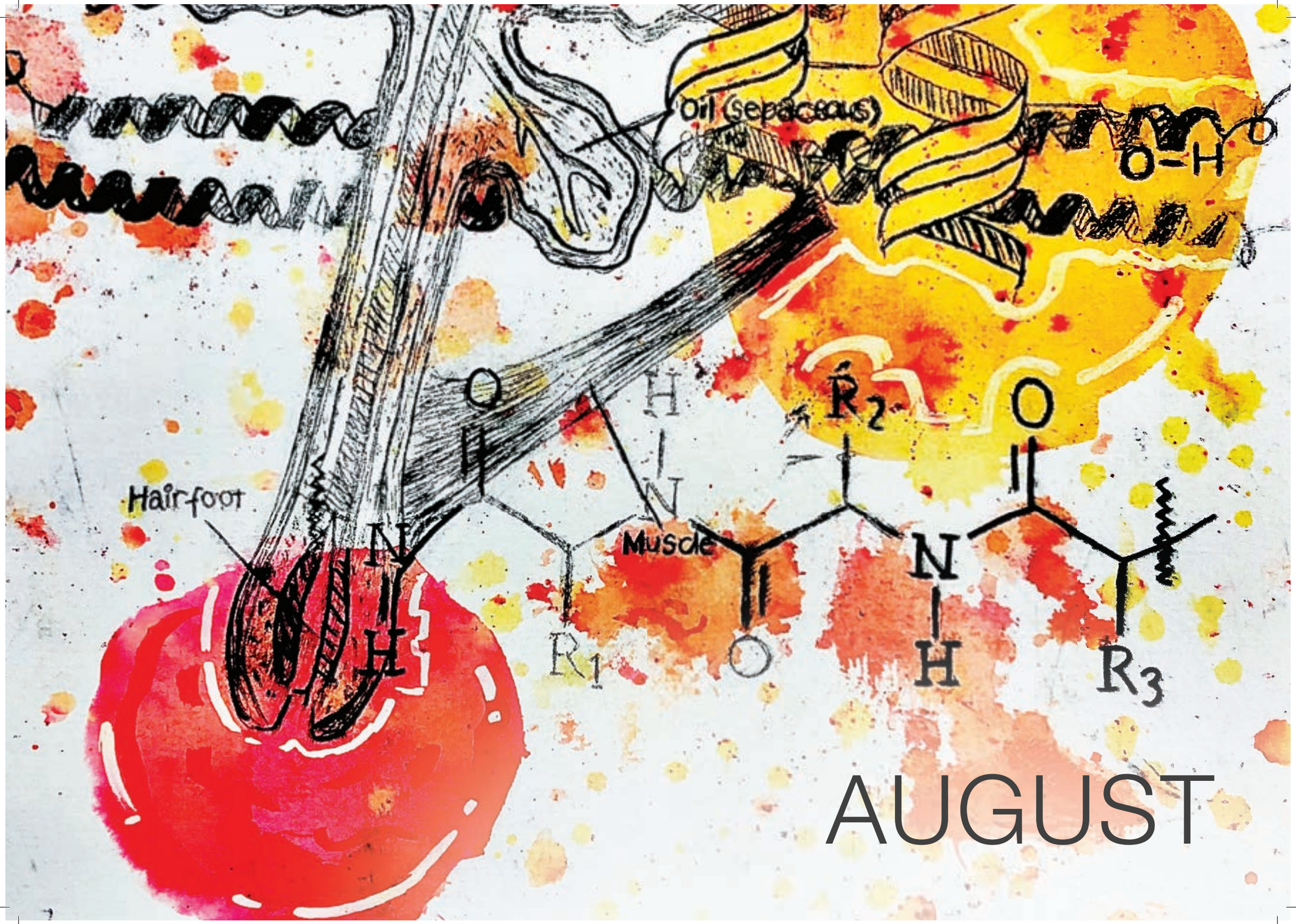
Plants require hormones to regulate their growth. Abscisic acid (ABA) is one of the hormones that supports plant development and response to stresses such as drought and salinity. ABA causes small pores in plant leaves - called stomata - to close during drought in order to reduce evaporation and save water. ABA also controls seed dormancy and ensures that a seed only germinates when the conditions are favourable. Furthermore, ABA helps plants protect themselves against various pathogens.

When John first saw the ABA receptor 3D structure, he thought it resembled a brain, and found it intriguing that it is actually found in plants. The artwork features a main stem shaped with clay to represent the protein, with painted lines representing amino acids, and paper folded into the shape of flowers to highlight the role of this protein in plant growth.

Sculpture with mixed media
John Wu

PDBe.org/5mmq/3d





AUGUST

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PDBe
Protein Data Bank in Europe

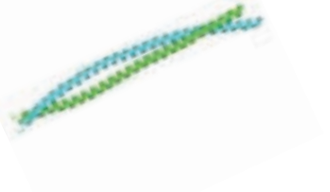
Nails in the coffin

The health of our fingernails, hair, and skin relies on the amount of keratin in our body. There are over 50 different types of keratin found in humans with at least half of these present in hair follicles. This natural protein shows immense biological stability which provides strength to our internal organs and maintains the elasticity of our skin. Keratin has a simple coiled-coil helical structure rich in the amino acid cysteine, and has the ability to self-assemble into bundles of fibres.

Jahnavi found it interesting that this fibrous protein is incredibly stable and completely insoluble in water or other solvents. Hence, mummified bodies can maintain their hair and nails even after many centuries.

Drypoint etch and printing
Jahnavi Manya

PDBe.org/3tnu/3d



SEPTEMBER

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Protein Data Bank in Europe

Tangles in the brain

This textile artwork features a ball of wool depicting the deposits which form tangles in Alzheimer's disease. In this progressive neurodegenerative disorder, the brain slowly loses memory and cognition, and eventually the patient is no longer able to carry out simple day-to-day tasks. It is thought to be caused by the abnormal build-up of proteins in and around brain cells. One of the proteins involved - called amyloid - can accumulate to form plaques around brain cells. Another protein - called tau - forms tangles within brain cells.

Amelia exquisitely portrayed both of these proteins in this piece. While drugs may improve memory and reduce confusion moderately, there is still no cure to stop Alzheimer's disease from worsening over time.

Sculpture with felt, feathers, etching, and printmaking
Amelia Mital

PDBe.org/4xxd/3d

OCTOBER

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PDBe
Protein Data Bank in Europe

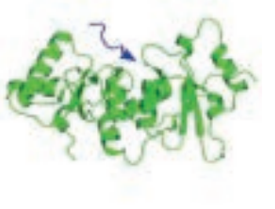
Fluidity

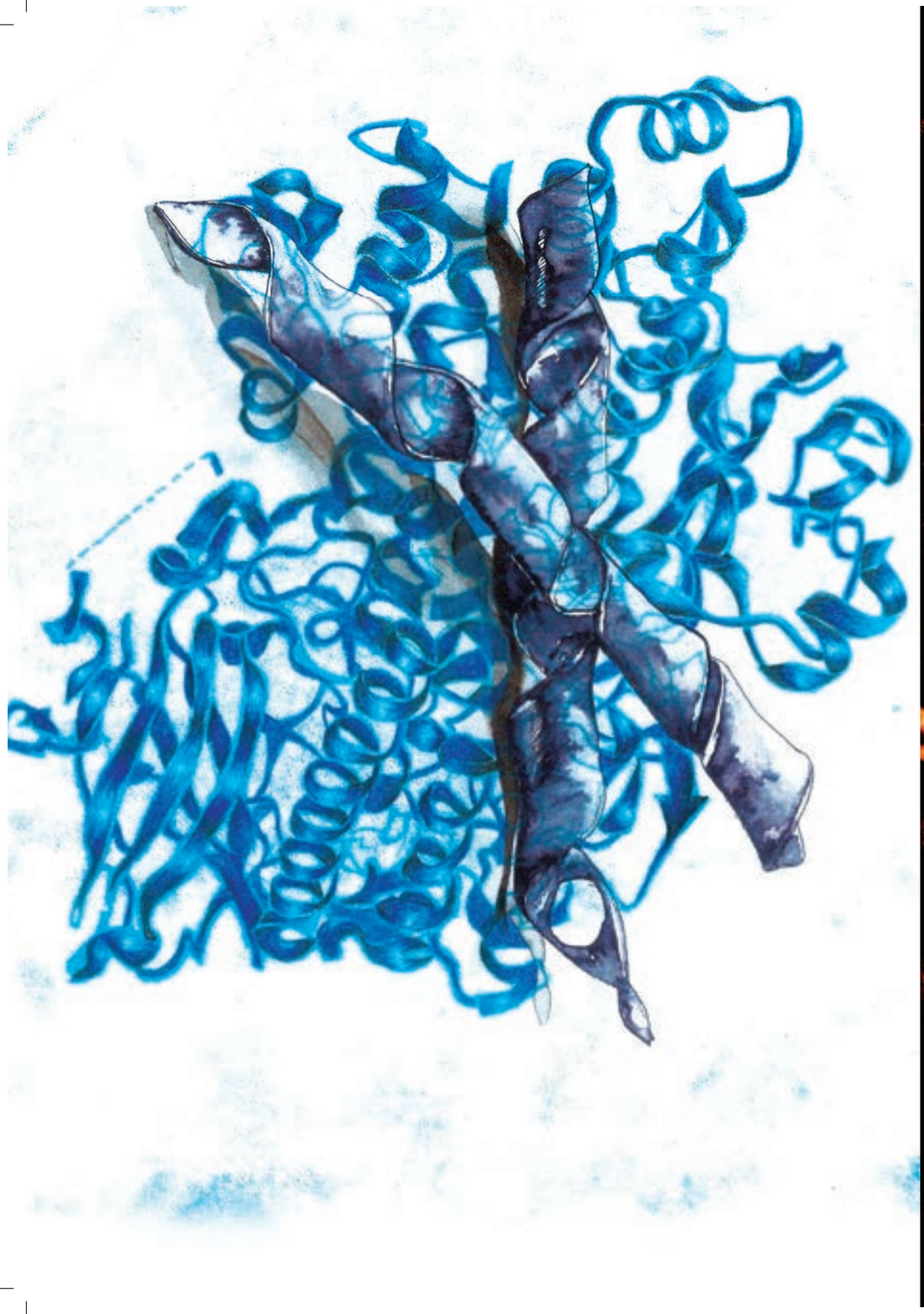
Genetic mutations often occur when our cells divide. Often these changes to our DNA have no impact on our health, but sometimes they cause diseases, such as cancer. BRCA1, a tumour-suppressor gene - also known as a caretaker gene - is responsible for repairing DNA. Mutations in BRCA genes interrupt the very well-controlled process of DNA repair, and this can lead to breast cancer.

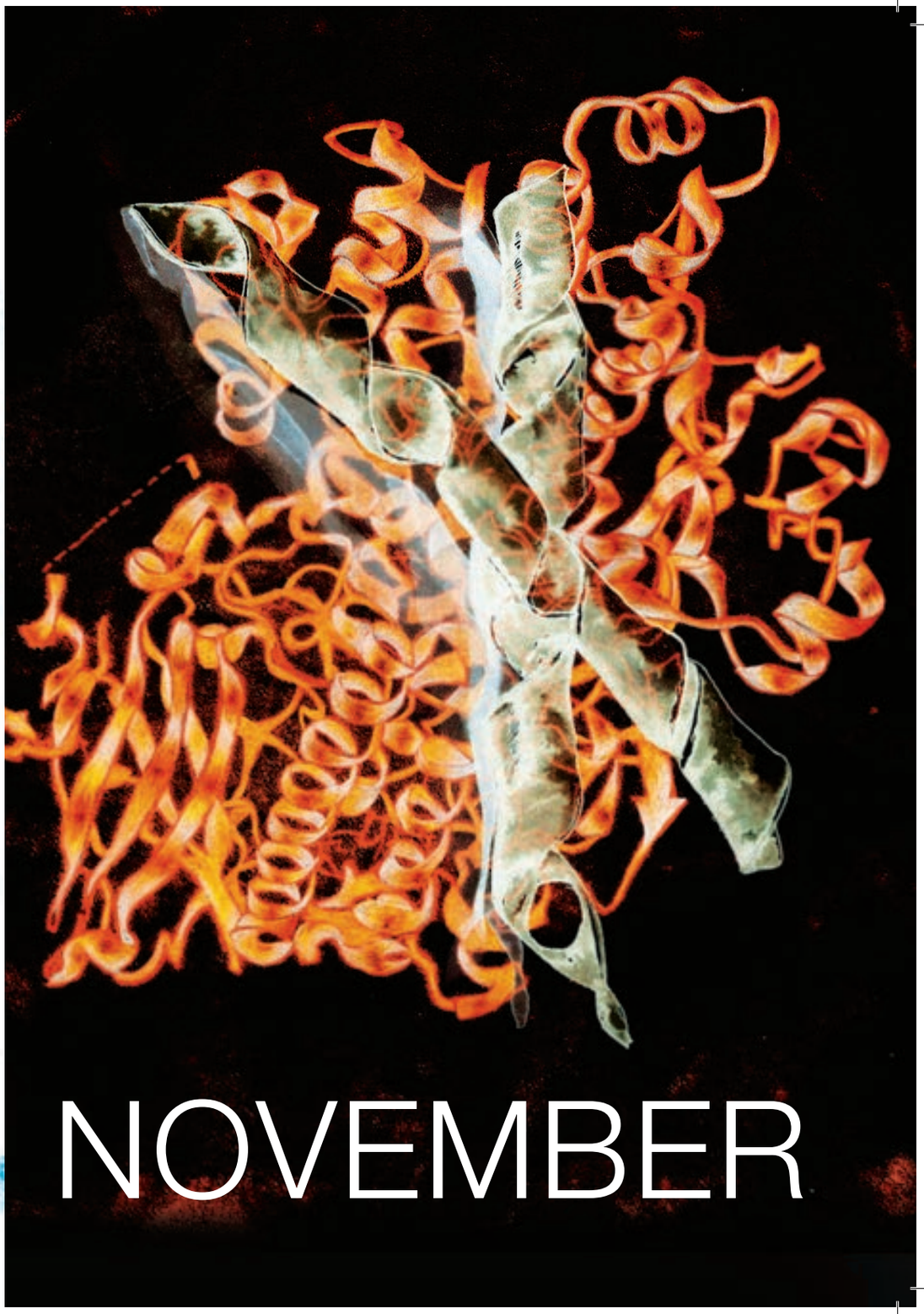
This artwork is a diptych sculpture constructed using wire and textile. Aimee wanted to capture the theme of fluidity, around cancer growth and the mutations associated with it. The red ribbons exhibit the direct course of cancer growth and the contrasting blue ribbons show where it terminates leading to death.

Sculpture with wire, textile, and diptych painting
Aimee Massara

PDBe.org/4y2g/3d



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PDBe
Protein Data Bank in Europe

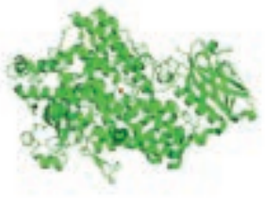
Proteins and seed pods

Lipoxygenases are large, iron-containing enzymes found in plants, animals, bacteria, and fungi. They catalyse the oxidation of polyunsaturated fatty acids to produce highly reactive hydroperoxides. These hydroperoxides are capable of altering the flavour, aroma, and appearance of food. They are therefore sometimes used in the food and beverage industry to improve the physical and chemical characteristics of ingredients.

Thanatpohn's artwork focuses on lipoxygenase from soybean, with the spiral seed pods in the artwork drawing parallels to the alpha-helical structure of the protein.

Paint with monoprint
Thanatpohn Siriwatdeachakul

PDBe.org/1f8n/3d




DECEMBER

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PDBe
Protein Data Bank in Europe

A matter of taste

Have you ever noticed that a salty cracker starts to taste sweet after you've chewed it for a while? This is due to the enzyme salivary amylase in our saliva, which is the focus of this artwork. This enzyme rapidly breaks down the starch in foods such as bread, crackers, rice, potatoes, and pasta into simple sugars, giving our palate a sweet taste. Apart from having hydrolyzing activity, salivary amylase can be adsorbed onto the tooth enamel, where it binds the amylase-binding bacteria and contributes to the formation of dental biofilm also referred to as plaque. There is also evidence to suggest that salivary amylase plays an essential role in the protection of dental surfaces from caries.

Inspired by the beautiful structure of this protein, Aiza created her artwork using etching, printing, and digital tools.

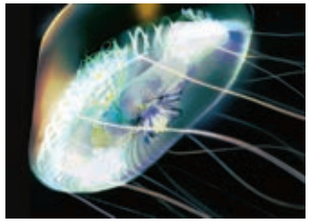
Etching, printing, and photoshop
Aiza Saeed

PDBe.org/1mfv/3d

About the PDB Art project and the artists

The project is a collaboration between the Protein Data Bank in Europe (PDBe), The Arts Society Granta, The Arts Society CANTAB, and several UK schools including The Leys, The Perse, The Stephen Perse Foundation, Impington Village College, Saffron Walden County High, Thomas Gainsborough, Leventhorpe, Sybil Andrews Academy, and Viewbank College in Australia. Students used 3D structures of molecules in the PDB archive as inspiration for their artworks, created within their school's art curriculum. Some of the resulting artworks from the students are featured in this calendar. PDBe is part of EMBL's European Bioinformatics Institute (EMBL-EBI), based on the Wellcome Genome Campus in Cambridgeshire, UK. We thank the campus Wellcome Connecting Science Public Engagement team for their help. For more information, visit PDBe.org/art

Cover art: Genetically encoded biosensors



This digital artwork was inspired by a video of a rare jellyfish called *Chirodectes maculatus* that exhibits biofluorescence. Such light-emitting organisms occur across the spectrum of life, and glow in brilliant fluorescent colours including blues, greens, and reds. One of the greatest applications of these fluorescent proteins is in real-time monitoring inside cells. They are therefore used as research tools to better understand the function and regulation of cellular processes.

PDBe.org/1kys/3d

Siqi Li

Siqi, aged 16, is a student at The Stephen Perse Foundation in Cambridge. Her favourite hobbies are animation and studying animals. Siqi found the PDB Art project especially interesting as it combined science and art. In addition, she appreciated how visualising protein structures helped in understanding proteins.

Isaac Noblet

Isaac, aged 12, is a student at Thomas Gainsborough School in Sudbury. His favourite subjects are IT, media, and physical education. He enjoyed learning about different paper cutting and curling techniques. His favourite hobbies include karate, gaming, and trampolining.

Beatrice Gibbons

Beatrice, aged 16, is a student at The Leys School in Cambridge. She likes taking photographs when travelling. She loves to recycle her clothes and likes being very organised and neat.

Yasmin Martin

Yasmin, aged 16, is a student at the Saffron Walden County High School. She really enjoyed using lots of media, combining them to produce mixed media compositions for her art piece, and found the PDB Art project quite fulfilling. She has a strong interest in arts and wants to develop her skills further in A-Levels and at university.

Hayley Yuen

Hayley, aged 16, is a student at The Stephen Perse Foundation in Cambridge. She enjoys drawing and crafting during her leisure time. She had never created artworks that merged science and art before, so she found the PDB Art project to be particularly intriguing. After this experience, she has a better knowledge of proteins through visualising protein structures.

Oscar Higham

Oscar, aged 16, is a student at the Saffron Walden County High School. He is studying art and design and wants to study fine art at university. He was intrigued about how art and science could be interlinked with one another despite being such different subjects. He enjoys ukulele, singing, boxing, photography, and gaming.

Luke Hogan

Luke, aged 13, is a student at The Perse School in Cambridge. He uses art as a way to show emotions and to relax in his free time. He also has an interest in sports, particularly cricket and rugby.

John Yu

John, aged 16, is a student at The Leys School in Cambridge. He is interested in maths and science, and finds art to be a way to relieve stress. In his free time, he enjoys playing sports including basketball and rugby, and likes to visit art exhibitions.

Jahnavi Manya

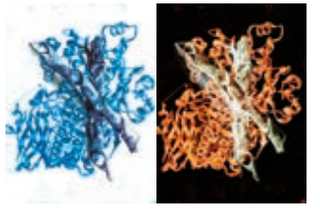
Jahnavi, aged 13, is a student at The Perse School in Cambridge. She enjoys studying art, design & technology, English, and history at school. Her hobbies include working with clay, painting, and reading.

Amelia Mital

Amelia, aged 16, is a student at The Leys School in Cambridge. She enjoys printing and creating art based on the human body. In her spare time, she loves to cook which she finds very therapeutic. She also loves playing tennis and volleyball.

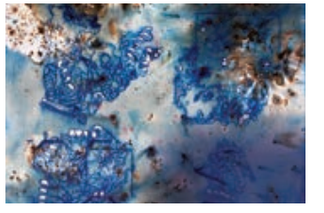
Aimee Massara

Aimee, aged 17, is a student at The Stephen Perse Foundation in Cambridge. She found the PDB Art project really interesting due to its overlap between science and art, which made her realise the importance of art in visualising and communicating science. She wants to study chemistry and found this experience very valuable.



Thanatpohn Siriwatdeachakul

Thanatpohn, aged 19, is a student at The Stephen Perse Foundation in Cambridge. She is studying biology at A-level. The beauty of art inspired by science is what she is fascinated by the most. She appreciates how the PDB Art project helped her to convey the elegance of molecular biology and this made her biology learning even more enjoyable.



Aiza Saeed

Aiza, aged 13, is a student at The Perse School in Cambridge. Aiza looks forward to bringing more scientific references into her GCSE artwork next year as well as extending her creativity in etching and printing skills.

THE ARTS SOCIETY GRANTA

CANTAB

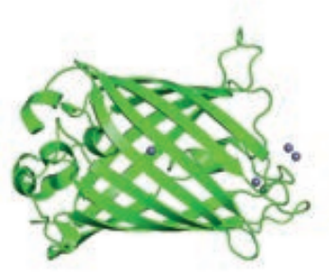
+

wellcome connecting science

PDBe Protein Data Bank in Europe

EMBL-EBI

About the proteins



Cover

PDBe.org/1kys/3d

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January

PDBe.org/2a53/3d

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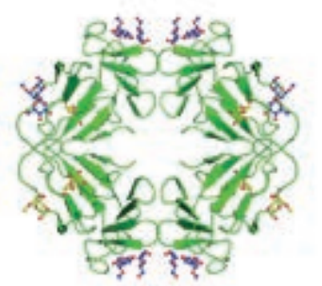

February

PDBe.org/1niv/3d

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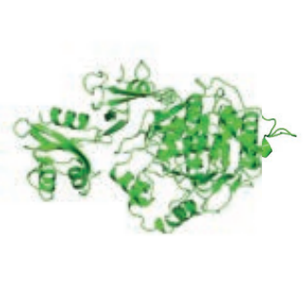

March

PDBe.org/1lci/3d

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April

PDBe.org/1qmw/3d

Solution structure of alpha-conotoxin Si. Benie *et al.* FEBS Lett. (2000)

May

PDBe.org/2psd/3d

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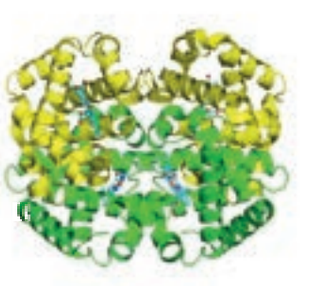

June

PDBe.org/2hhb/3d

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July

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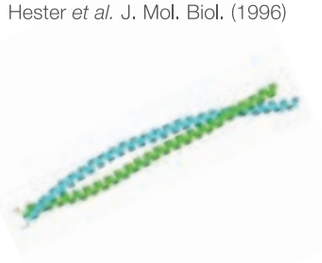

August

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September

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October

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November

PDBe.org/1f8n/3d

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December

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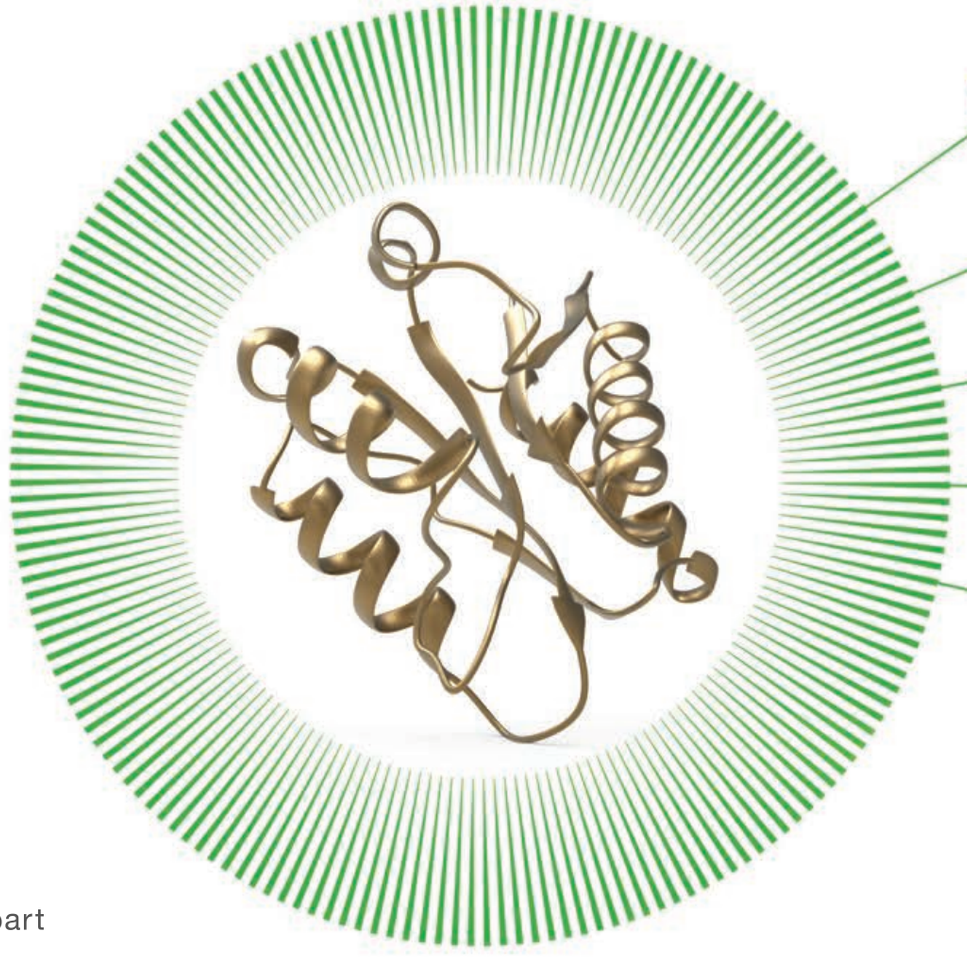
PDBe-KB

Protein Data Bank in Europe - Knowledge Base



- Functional annotations
- Publications
- Interactions
- Structures
- Ligands

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