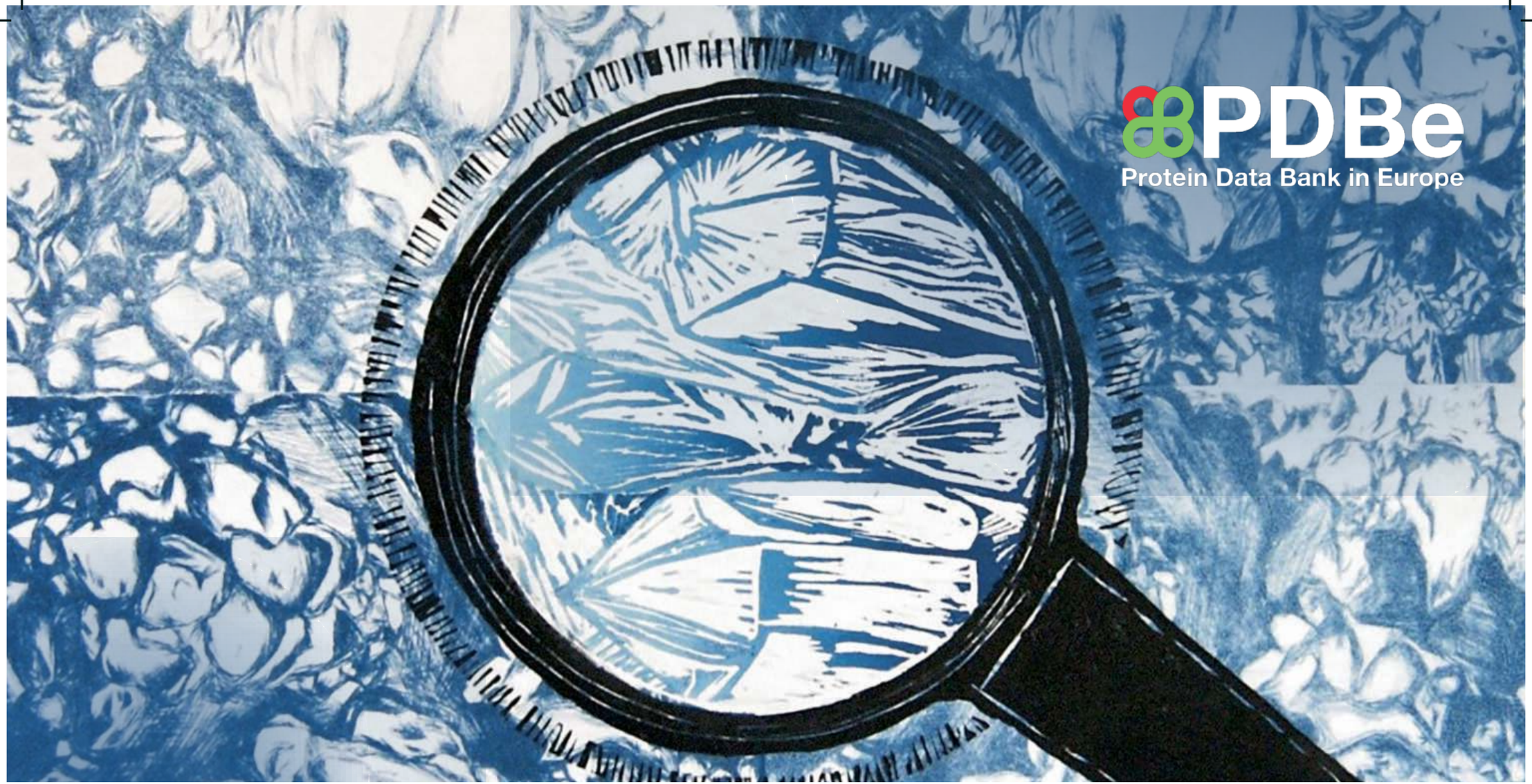
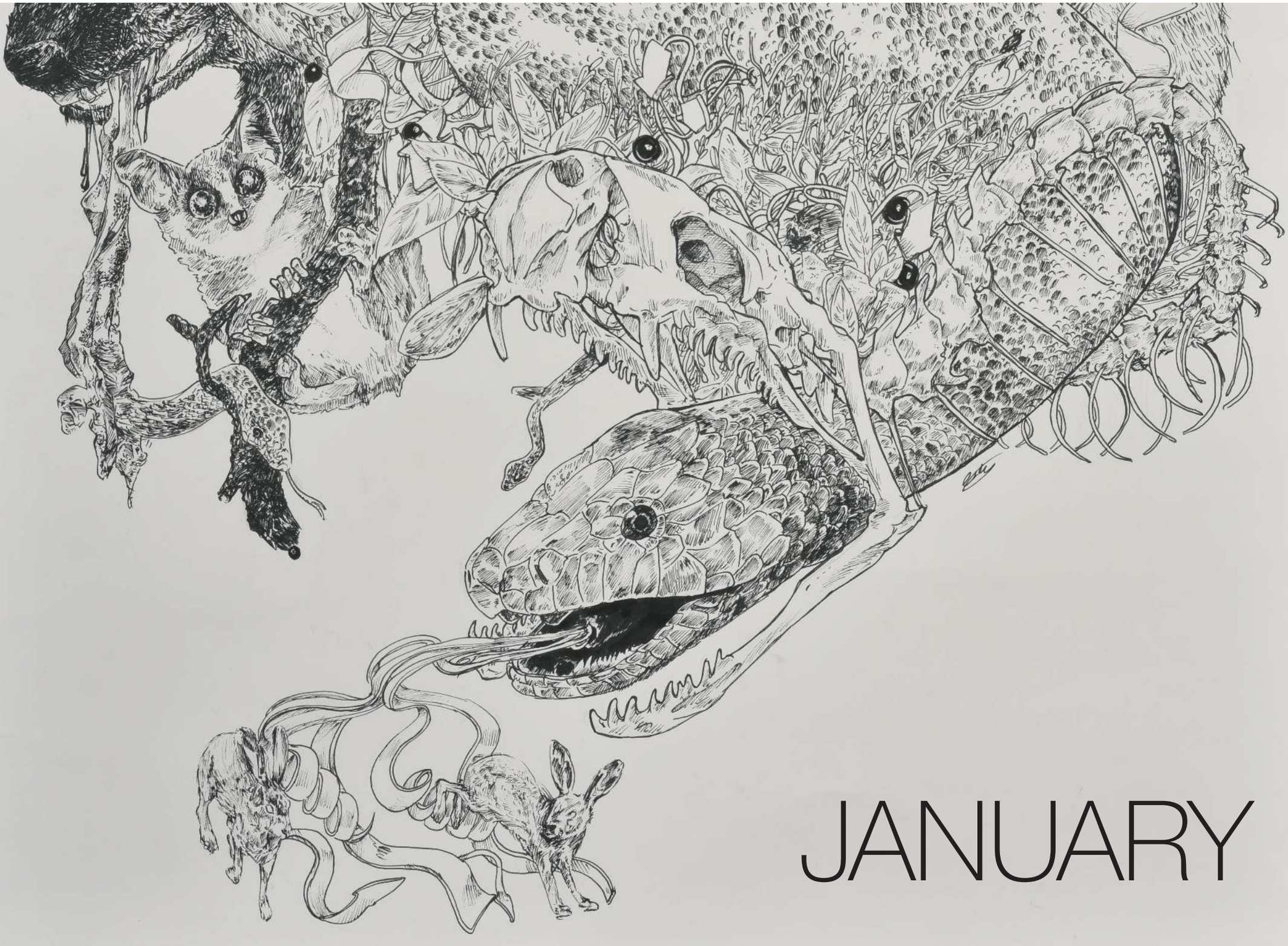


2020 CALENDAR

Emotions in science



JANUARY

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PDBe
Protein Data Bank in Europe

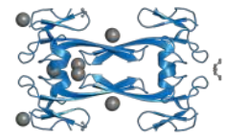
Toxins

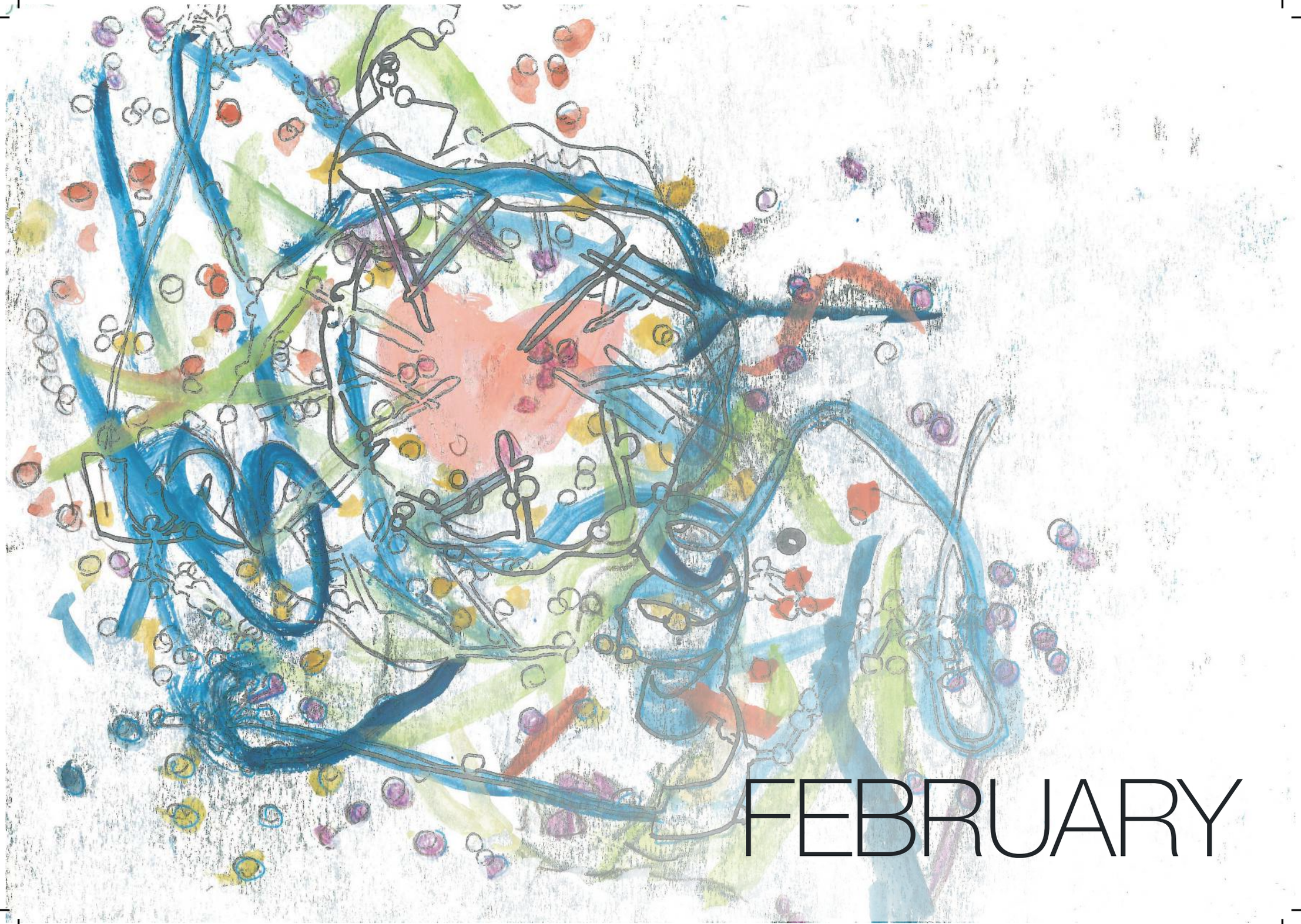
Venomous creatures such as jellyfish, scorpions and certain snakes can be frightening or repulsive, but they are also intriguing. Ayshini was interested in researching the 'evolution of biological weapons', and asked why some animals develop harmful toxins while most mammals and birds do not.

During her study she found a vast number of toxin structures available in the PDB archive. One such toxin, mambalgin-1, is a pain-relieving peptide found in black mamba snake venom. Combining her scientific study with her interest in the arts, she produced this artwork as a representation of her toxin-related findings.

Pen and ink
Ayshini Senadeera

PDBe.org/5do6/3d




FEBRUARY

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PDBe
Protein Data Bank in Europe

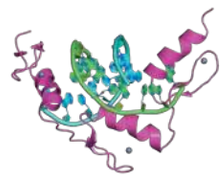
A grip on the heart

This artwork features the interaction between DNA and proteins in an 'emotionally' artistic fashion. With the heart as the focus of the artwork, Shuhan relates the centrality of one's emotions and feelings to the vital role that DNA plays in life. She takes her inspiration from Zinc finger proteins.

Zinc fingers are one of the most abundant and diverse families of DNA-binding proteins encoded in the human genome. Involved in several biological functions, these proteins recognise a wide range of very specific DNA sequences to switch genes on or off. Targeted gene editing using Zinc finger proteins are beginning to show promise as gene therapies for diseases like HIV/AIDS, haemophilia, sickle cell anaemia and many others, but are still in the very early phases of drug development.

Combination of drawing and painting
Shuhan (Catherine) Wang

PDBe.org/1a1i/3d




MARCH

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PDBe
Protein Data Bank in Europe

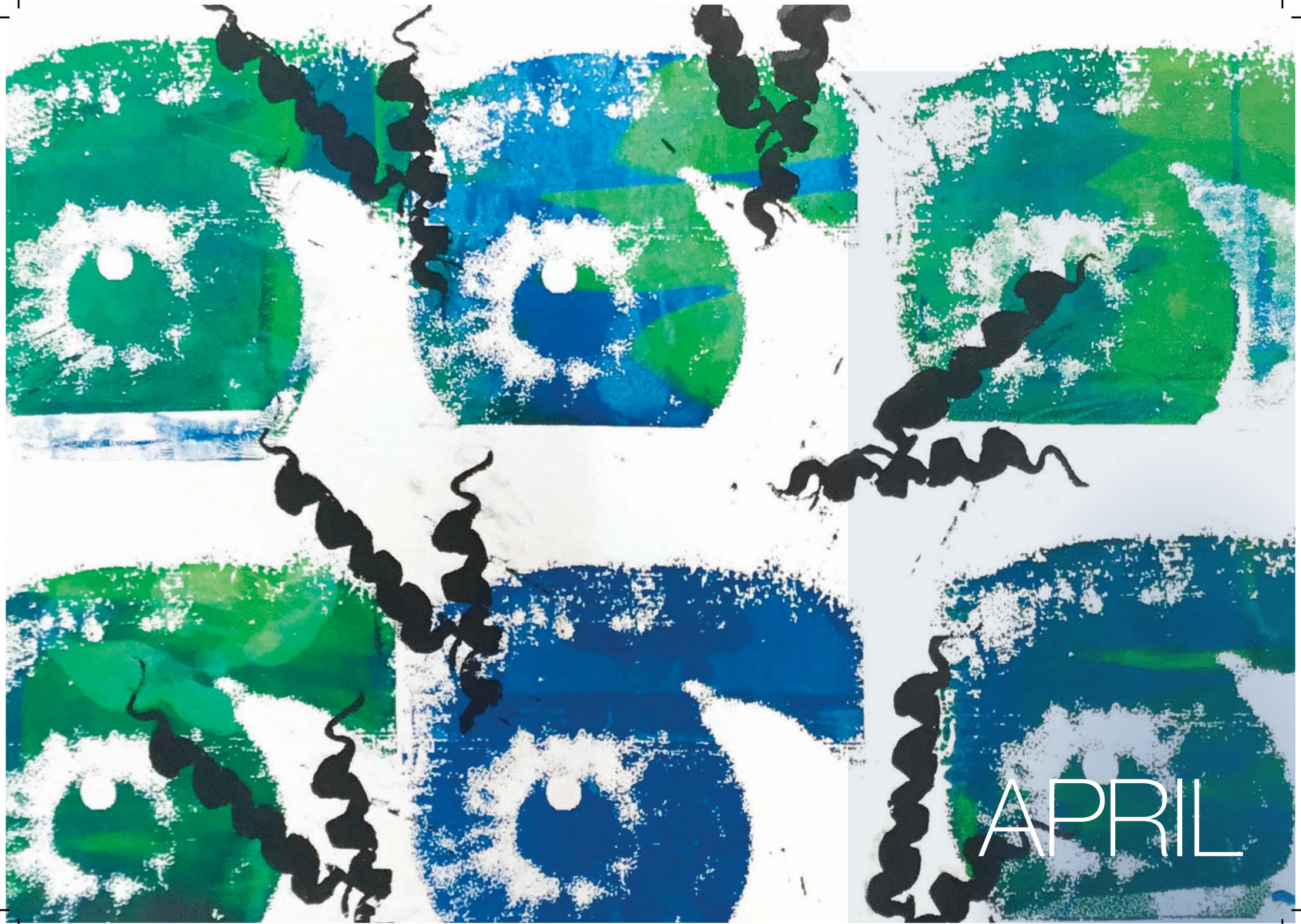
Beauty and pain

Bees are a sign of a healthy environment and play an important role in growing fruit and vegetables. This artwork depicts two aspects of our encounters with bees. The flowers at the bottom of the piece show the beauty of nature and the bees' role in pollination, while the bee venom protein above represents danger and pain. The contrast between the bright, warm colors of the flowers and dark colors of the protein highlights these two facets.

Bee venom contains a complex mixture of proteins such as phospholipases and melittin. The artwork shows phospholipase A2, an enzyme that controls the release of arachidonic acid which in turn causes pain and inflammation.

Combination of paint and monoprint tracing
Tiernan Leschner

PDBe.org/1poc/3d


APRIL

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PDBe
Protein Data Bank in Europe

Vision

Rhodopsin is the primary photoreceptor molecule in vision. It is an extremely light sensitive protein that contains a light absorbing chromophore derived from vitamin A. On exposure to light, rhodopsin undergoes a change in its shape initiating signal transduction. In this way, light is converted into an electrical signal that is transmitted to the brain where an image is perceived.

The artwork features green and blue eyes with a superimposed protein helix representing rhodopsin, a protein containing seven helices.

Screen printing
Georgie de Grey

PDBe.org/3pxo/3d


MAY

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PDBe
Protein Data Bank in Europe

Origami with jellyfish

The amino acids within a protein chain dictate its 3D structure, or fold. Correct protein folding is vital for protein function in all cellular processes. Many pathological conditions develop due to misfolded or unfolded proteins, caused either by errors during protein synthesis or by cellular stress. Such defects can often be rescued by molecular chaperone systems which promote correct folding of proteins.

This artwork features one such chaperone, prefoldin, which resembles a jellyfish in shape. The far end of the long tentacle-like helices have exposed hydrophobic patches to bind misfolded proteins. Eukaryotic prefoldin has an important and specific role in the regulation of microtubule dynamics, while the archaeal prefoldin has a more generic role in helping proteins to fold.

Print and Brusho
Erin Baker

PDBe.org/1fxk/3d


JUNE

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PDBe
Protein Data Bank in Europe

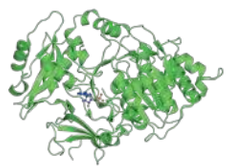
Glowing in the dark

Many organisms emit light via a process called bioluminescence. They do so for survival, reproduction, camouflage or communication. Inspired by the glow of fireflies that fill the night sky, the 'glowing effect' of this artwork was created by brightening the white lines using pastel and paint.

This piece features the structure of luciferase, an enzyme that catalyses the oxidation of luciferin, resulting in the emission of light. A technique called bioluminescence imaging uses the light produced by luciferase to allow visualisation of molecular processes within a cell, thus harnessing this living light to observe the invisible world.

Inverted pen drawing with chalk and acrylic paint
Elizabeth Brown

PDBe.org/2d1q/3d




JULY

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PDBe
Protein Data Bank in Europe

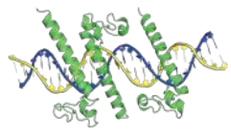
Engendering form

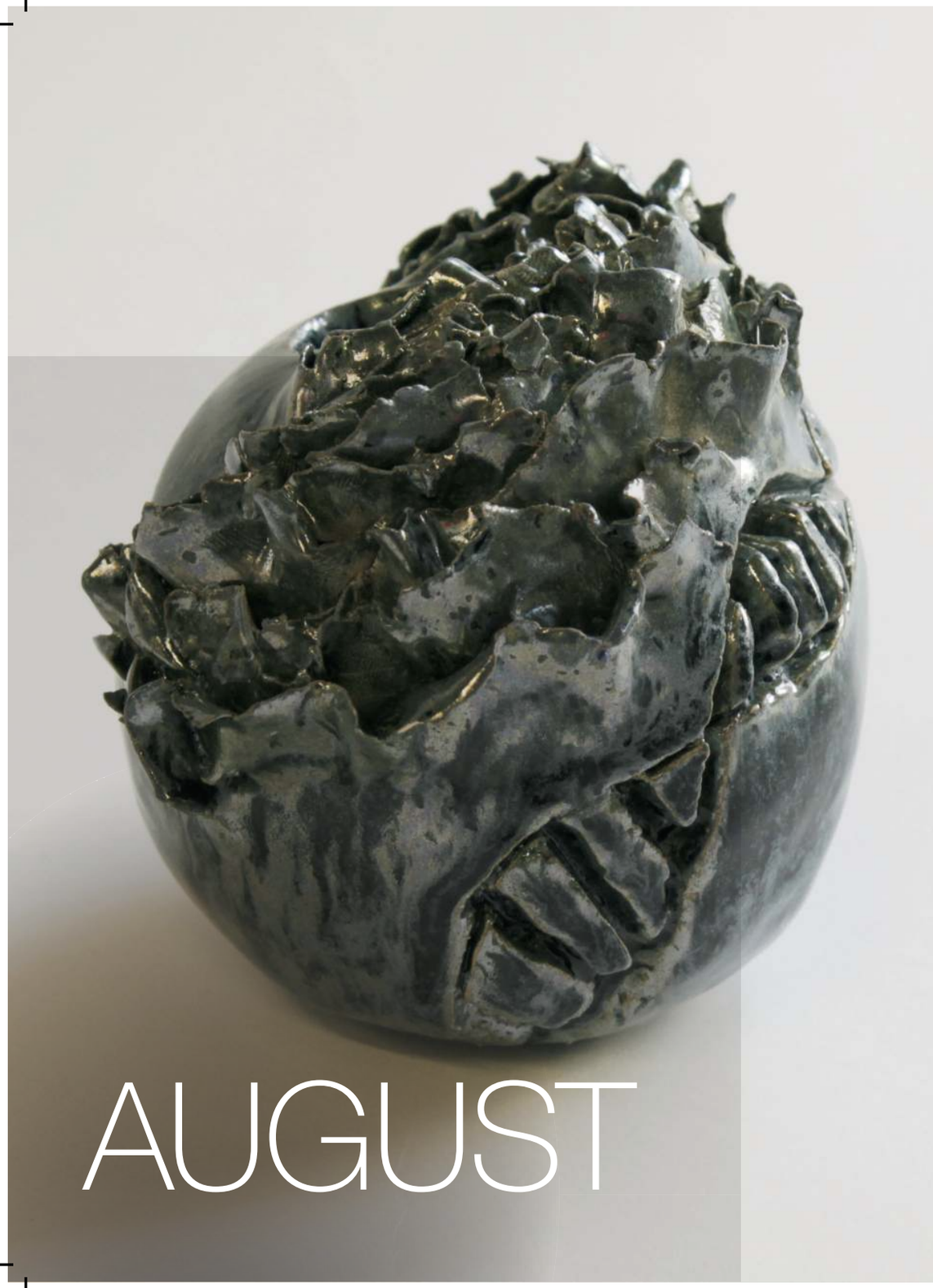
A class of 13-year olds explored the theme of 'the body', from the cellular to the molecular level. Students looked at structures in PDBe, initially focusing on haemoglobin and then moving on to other molecules in the PDB archive. Molecular structures were ideal subjects for developing skills in creating 3D form through tone, using a medium of chalk and charcoal.

Molecules studied included proteins that bind to DNA, such as the one depicted in this artwork by Daniel Chen, who took inspiration from an ancient protein-DNA interacting motif found in DMRT proteins. These proteins are critical in sexual differentiation and determining gender. Without it, the default female characteristics are more dominantly expressed with little or no male features.

Chalk and charcoal drawing
Daniel Chen

PDBe.org/4yj0/3d





AUGUST

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PDBe
Protein Data Bank in Europe

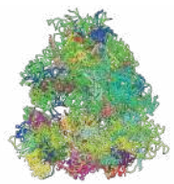
Protein-making machines

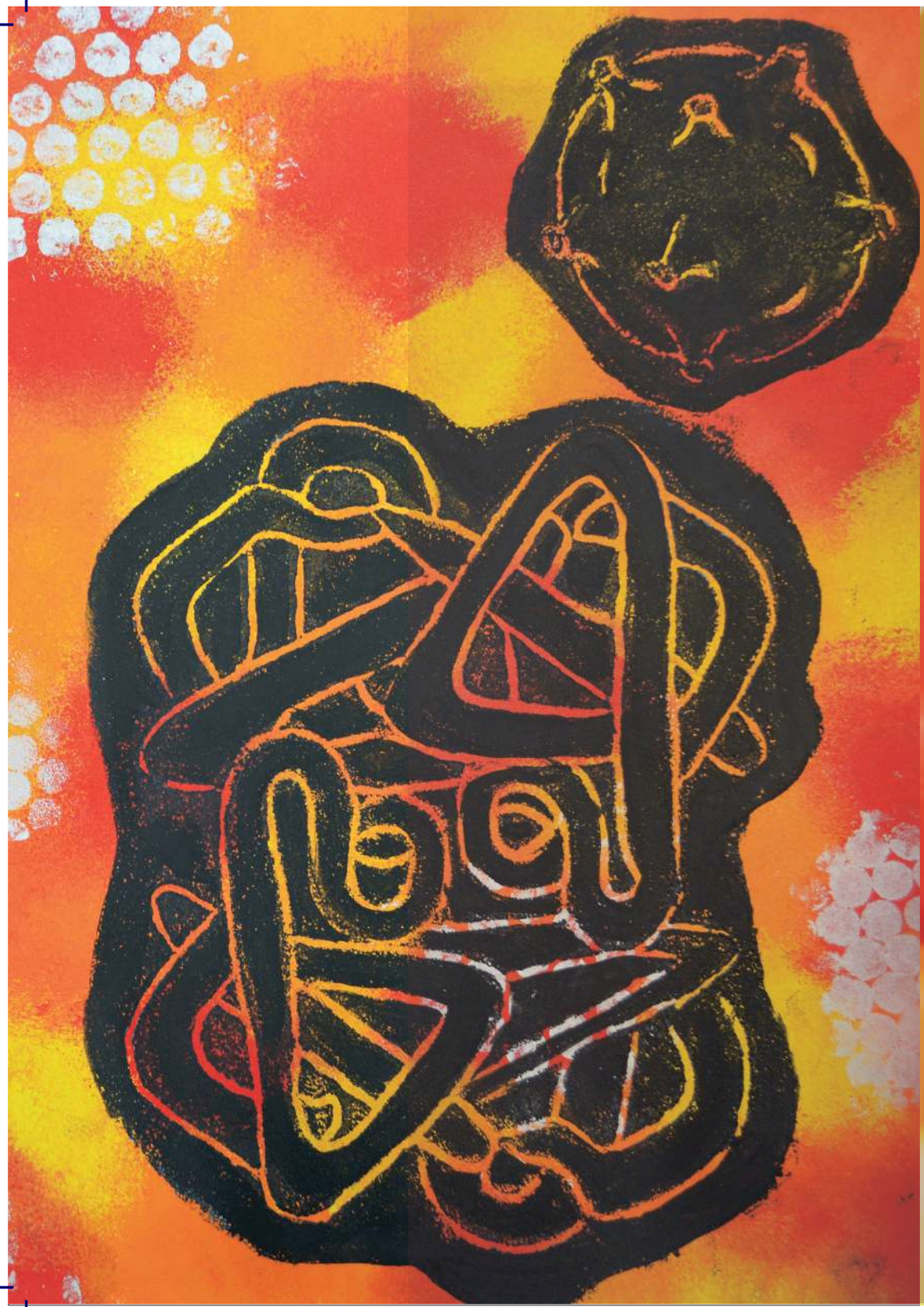
This ceramic sculpture (left) and silk batik piece (right) are both artworks inspired by the structures of DNA and proteins. The artist, Sheen, explains that the DNA strand which wraps around the base of her sculpture reflects the fact that all proteins initially come from DNA. The delicate ruffles gathered around the top of the sculpture are inspired by Laura McNamara, a ceramic artist.

DNA carries the genetic code, which small molecular machines called ribosomes convert into proteins to carry out the functions necessary for life. Marie's batik artwork features a representation of the process of protein synthesis. Protein molecules being formed are shown as small circles, alongside a fully mature protein, represented by a red alpha helix at the bottom right.

Ceramic sculpture (L);
Silk batik (R)
Sheen Gahlaut
Marie Bischofs

PDBe.org/6ek0/3d





SEPTEMBER

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PDBe
Protein Data Bank in Europe

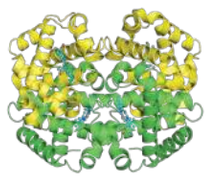
Molecule of life

Oxygen is an essential molecule for humans. In order to survive, we must transport oxygen from our lungs to all the cells around the body that need it. Haemoglobin, a molecule found in our red blood cells, is responsible for transporting oxygen within the body. Along with myoglobin, haemoglobin was one of the very first proteins to have its structure determined, earning Max Perutz and John Kendrew the 1962 Nobel Prize in Chemistry.

Each red blood cell contains an astounding 280 million haemoglobin molecules, enabling 70 times more oxygen to be transported around the body than if it were simply dissolved in water. This amazing molecule is the inspiration for these two very different artworks: one is a print, illustrating the 3D structure of haemoglobin (left), while the other (right) is a sculpture depicting a collection of red blood cells and viruses within a blood vessel.

Print (L); Sculpture (R)
Daisy Barton Gilheany
Rebecca Koch

PDBe.org/4hhb/3d




OCTOBER

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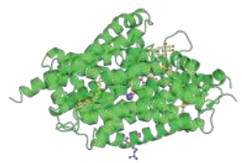
PDBe
Protein Data Bank in Europe

Activity of the mind

This piece is inspired by mental illness and how diseases such as depression can occupy the mind. The dark swirling background surrounding the silhouette of a person encapsulates feelings related to mental illness. The brain is depicted in bright colours, highlighting the activity of the mind in these conditions. Overlaid onto the brain is the structure of a neurotransmitter transporter, a protein that is important for conveying signals in the brain. Bleach was used purposefully and artistically to create the colour change around the swirling patterns, mirroring the way that depression removes the colour from someone's life.

Combination of print, photoshop and ink drawing
Imogen Phillips

PDBe.org/2q72/3d




NOVEMBER

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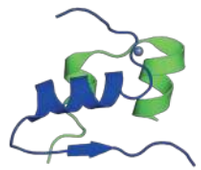
PDBe
Protein Data Bank in Europe

Sweet balance

This suspended sculpture, made from wire and tissue paper, represents the peptide hormone insulin, the structure of which was first determined in 1969 by Nobel Prize winner Dorothy Hodgkin. A fine balance of insulin is required for the regulation of sugar levels in the blood. Too much insulin can lead to low blood sugar levels causing confusion, dizziness and fainting. Low insulin production results in high blood sugar, which can lead to serious health issues if not controlled. People with diabetes do not produce enough insulin and therefore have to monitor their blood sugar levels carefully, either through diet, or administering insulin in order to control these levels.

Wire and tissue paper sculpture
Sydney Jaikaran-Roberts

PDBe.org/4ins/3d




DECEMBER

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PDBe
Protein Data Bank in Europe

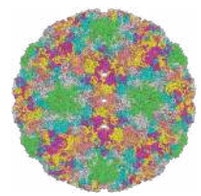
The unseen battle

The inspiration for the development of this ceramic piece comes from the structures that we see in living organisms at a microscopic level. Nicholas was interested in proteins that repair damaged DNA along with Human Papillomavirus (HPV), both of which have an impact in cancer. While most people will be infected with HPV during their lifetime, it is usually dealt with effectively by the immune system. HPV infection increases the replication rate of cells and, on rare occasion, can contribute to the development of cancers.

This sculpture is inspired by the structure of HPV, with the perforations on the main body, a stylised simplification of the symmetrical building blocks of the viral capsid. The spike-like appendages reflect how viruses are often perceived.

Ceramic art
Nicholas Malasiotis

PDBe.org/5kep/3d



About the project and the artists

This project is a collaboration between Protein Data Bank in Europe (PDBe), The Arts Society Granta, The Arts Society CANTAB, and several Cambridge schools (The Leys, The Perse, The Stephen Perse Foundation and Impington Village College). School students used 3D structures of molecules in the PDB archive as inspiration for artworks produced within their school art curriculum and are featured in this calendar. PDBe is part of the European Bioinformatics Institute (EMBL-EBI), based on the Wellcome Genome Campus. We thank the campus Public Engagement Team for their help.

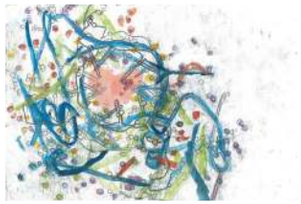
Investigating the process of crystallography

Isobel McMahon chose to study 'Elements' as a project theme and decided to look into protein crystallisation. Proteins in a solution can form crystals when the solution becomes 'supersaturated'. This causes protein molecules to come together in a symmetrical fashion, held together by forces called noncovalent interactions. The magnifying glass indicates how scientists can study these protein crystals to understand their structure.

Isobel, aged 17, is a student at The Leys and a friend of Royal Academy of Arts. In her spare time, she enjoys visiting art galleries and using different artists' work as inspiration for her own.

Ayshini Senadeera

Ayshini, aged 17, is a student studying chemistry, biology and maths at The Perse School. She likes art as a hobby and enjoyed creating a piece which melded her love for science and art.



Shuhan (Catherine) Wang

Shuhan (Catherine) is a 16-year-old student at The Stephen Perse Foundation and is studying mathematics, physics, and psychology. She likes to draw in her spare time.

Tiernan Leschner

Tiernan, aged 16, is a student at The Stephen Perse Foundation. She is studying english, biology, chemistry, maths, and German at A Level. She enjoys art and especially likes working with watercolors and clay.

Georgie de Grey

Georgie, aged 17, is a student at The Leys. One of her favourite leisure pursuits is photography and also experimenting with film. She loves to visit art galleries and exhibitions to get inspired by other artists and their work.

Erin Baker

Erin is a 13-year-old student at Impington Village College. She enjoys badminton and is a member of the Girl Guides. She is currently working towards the Baden-Powell challenge award.

Elizabeth Brown

Elizabeth Brown, aged 16, is a student at The Stephen Perse Foundation studying maths, chemistry, and physics at higher level for the International Baccalaureate. She also enjoys art, especially drawing and digital art.

Daniel Chen

Daniel, aged 13, is a student at The Perse School. He loves maths, drawing and coding.

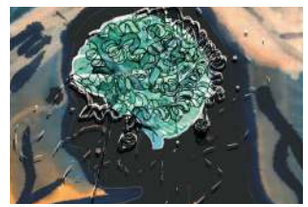
Sheen Gahlaut and Marie Bischofs

Sheen Gahlaut is a 13-year-old pupil at The Perse School. She is an avid artist and has a keen interest in all aspects of science, especially chemistry.

Marie Bischof, aged 13, is a student at Impington Village College. She is interested in art and music, and enjoys visual and performing arts.

Daisy Barton Gilheany and Rebecca Koch

Daisy Barton Gilheany and Rebecca Koch are 13-year-old students at Impington Village College. Both enjoy physical education and team sports along with art and science subjects.



Imogen Phillips

Imogen is a 14-year-old student at The Stephen Perse Foundation. Art is one of her favourite GCSE subjects. She finds that art puts her at ease and helps her feel comfortable in her school life.

Sydney Jaikaran-Roberts

Sydney is a 13-year-old student at Impington Village College. She enjoys painting and making sculptures. She also likes to dance and has an interest in science and maths.

Nicholas Malasiotis

Nicholas, aged 13, is a student at The Perse School. He enjoys drawing and working with clay in his free time. The shape of this piece was also influenced by the work of New York ceramic artist Pamela Sunday.

THE ARTS SOCIETY GRANTA

EMBL-EBI

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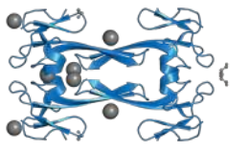
Protein Data Bank in Europe

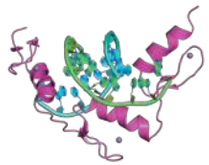
About the proteins



January

PDBe.org/5do6/3d

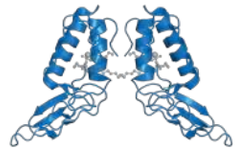
Mambalgin-1 pain-relieving peptide: stepwise solid-phase synthesis, crystal structure and functional domain for acid-sensing ion channel 1a inhibition. Mourier *et al*. J. Biol. Chem. (2015)



February

PDBe.org/1a1i/3d

High-resolution structures of variant Zif268-DNA complexes: implications for understanding zinc finger-DNA recognition. Elrod-Erickson *et al*. Structure (1998)



March

PDBe.org/1poc/3d

Crystal structure of bee-venom phospholipase A2 in a complex with a transition-state analogue. Scott *et al*. Science (1990)

April

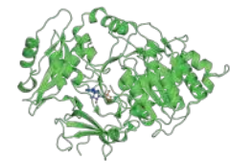
PDBe.org/3pxo/3d

Crystal structure of metarhodopsin II. Choe *et al*. Nature (2011)

May

PDBe.org/1fxk/3d

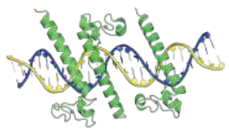
Structure of the molecular chaperone prefoldin: unique interaction of multiple coiled coil tentacles with unfolded proteins. Siegert *et al*. Cell (2000)



June

PDBe.org/2d1q/3d

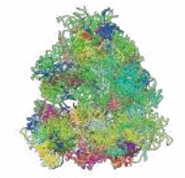
Structural basis for the spectral difference in luciferase bioluminescence. Nakatsu *et al*. Nature (2006)



July

PDBe.org/4yj0/3d

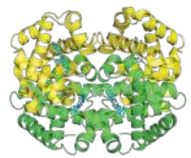
An ancient protein-DNA interaction underlying metazoan sex determination. Murphy *et al*. Nat. Struct. Mol. Biol. (2015)



August

PDBe.org/6ek0/3d

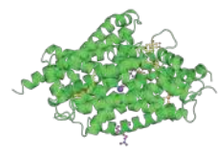
Visualization of chemical modifications in the human 80S ribosome structure. Natchiar *et al*. Nature. (2017)



September

PDBe.org/4hhb/3d

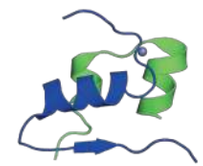
The crystal structure of human deoxyhaemoglobin at 1.74 A resolution. Fermi *et al*. J. Mol. Biol. (1984)



October

PDBe.org/2q72/3d

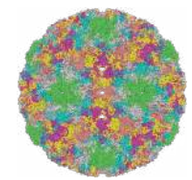
Antidepressant binding site in a bacterial homologue of neurotransmitter transporters. Singh *et al*. Nature (2007)



November

PDBe.org/4ins/3d

The structure of 2Zn pig insulin crystals at 1.5 A resolution. Baker *et al*. Philos. Trans. R. Soc. Lond. (1988)



December

PDBe.org/5kep/3d

Cryoelectron Microscopy Maps of Human Papillomavirus 16 Reveal L2 Densities and Heparin Binding Site. Guan *et al*. Structure (2016)

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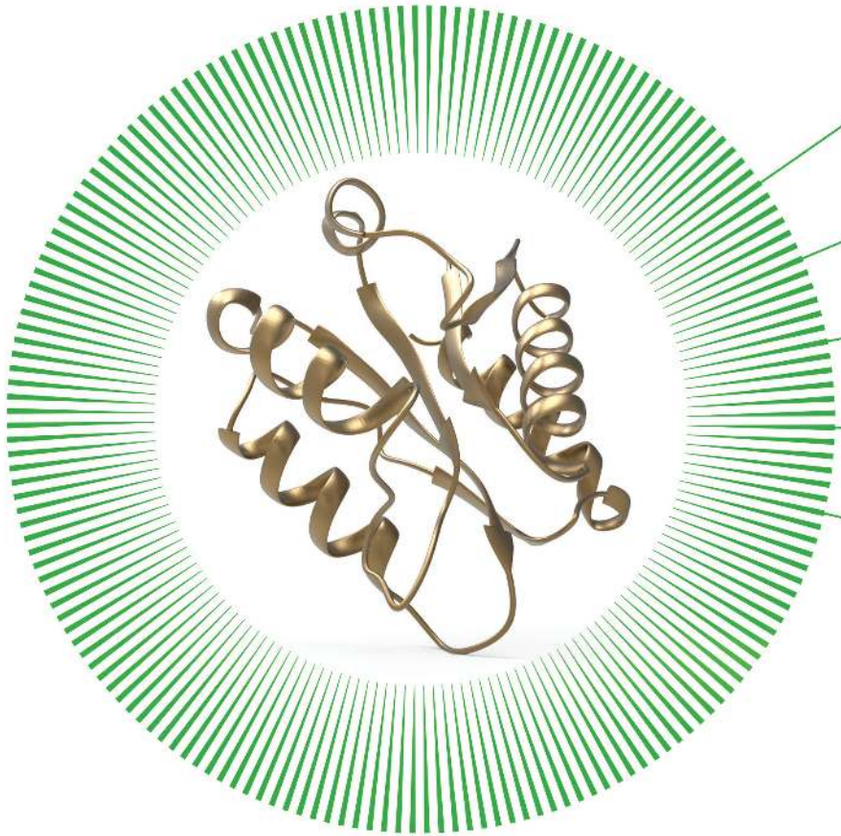

- Functional annotations
- Publications
- Interactions
- Structures
- Ligands

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