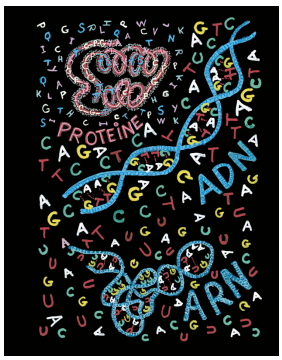
CHRISTIAN SARDET

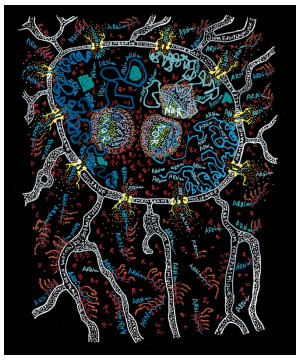
drawings by a biologist about the origin and evolution of life

January 26 - March 9, 2024

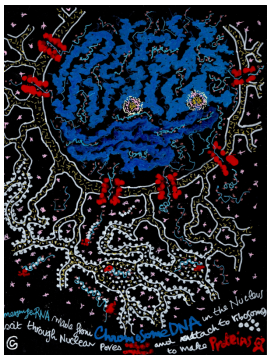
1. *Protein, DNA & RNA,* 2020, acrylic marker on paper
   11 5/8 x 8 1/4 inches, 16 x 15 inches matted
   NFS
   Proteins are polymers made up of 20 amino acids attached to each other, making a folded chain. The different amino acids (represented by letters) have particular properties. Nucleic acids – DNA and RNA – are also polymers, made up of nucleotides attached to each other. Four nucleotides (A, T, G, C) constitute a DNA strand. RNA differs from DNA in one of the nucleotides (U instead of T).



2. *The cell nucleus,* 2023, acrylic marker on paper
   12 1/2 x 9 3/8 inches, 16 x 15 inches matted
   NFS
   In eukaryotic cells (cells with a nucleus), protein manufacturing is initiated in the nucleus and completed outside. Here, three chromosomes (blue) are shown with special regions called NOR (for Nucleolar Organizer) which organize the formation of nucleoli (concentric regions in ocre, beige and pink colors) where ribosomes (R and r) are made. Messenger RNA (mRNA) transcribed from the DNA, as well as ribosomes migrate via pores (yellow) in the nuclear membrane from inside the nucleus to the cytoplasm. In the cytoplasm, ribosomes translate messenger RNAs into proteins.

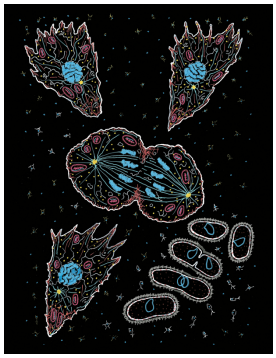


3. *From DNA to Proteins,* 2019, acrylic marker on paper
   11 x 8 5/8 inches, 16 x 15 inches matted
   $1,800
   The nucleus of the cell contains chromosomes (blue) and nucleoli (pink spherical bodies). The nucleus is made of a double membrane in continuity with a network of membrane tubes and sheets lined with ribosomes that manufacture proteins. Molecules such as messenger RNAs (blue strings) and proteins move in and out of the nucleus through nuclear pores (red).



4. *Cellules calligrammes,* 2019, acrylic marker on paper
   12 3/4 x 9 7/8 inches, 16 x 15 inches matted
   $1,800
   This "calligramme" represents an animal cell migrating (top) or dividing (bottom). Animal cells are delimited by a membrane (white), possess chromosomes (blue) encased in membranes (white) and organelles (organite in French) as well as a cytoskeleton constituted of microtubules (green) and microfilaments (red). When a cell divides chromosomes are duplicated and separated by microtubules.

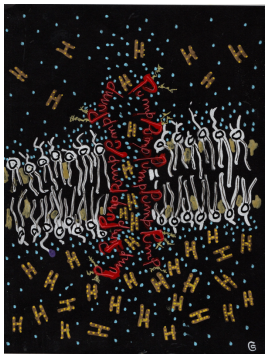
5. *From one to two cells,* 2020, acrylic marker on paper
13 3/4 x 9 3/4 inches, 16 x 15 inches matted
NFS
Living requires that cells are made from preexisting cells by division. In bacteria (bottom right) the mother cell lengthens, the unique chromosome duplicates into two and daughter cells, each containing a chromosome, are made by fission. In animal cells the process of division is called mitosis. During mitosis several chromosomes duplicate and separate into two daughter cells.



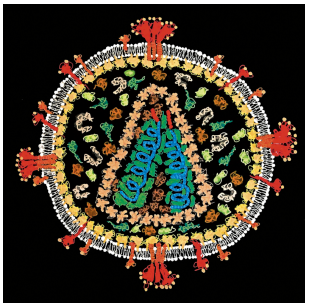
6. *Division,* 2019, acrylic marker on paper
10 5/8 x 8 1/4 inches, inches matted16 x 15 inches matted
$1,800
Animal cells divide by mitosis, a process of duplicating and separating chromosomes (blue) into 2 equal sets using microtubules (green). The mother cell then pinches into 2 daughter cells, using a ring of microfilaments (red). A nucleus forms around the chromosomes in each daughter cell.

7. *Virus & phages,* 2019, acrylic marker on paper
13 3/4 x 9 7/8 inches, 16 x 15 inches matted
$1,800
All cells are infected by viruses. Bacterial viruses – phages – multiply within infected bacteria and make them burst, releasing countless copies of phages outside. Animal viruses like COVID are made of genetic material (RNA in blue) protected by a membrane (white) studded with Spike proteins (red). The Spike proteins allow the virus to attach and enter the cell. Once inside, the viral RNA is copied. Multiple copies of viruses are produced that bud out of the cell with a small piece of its membrane.

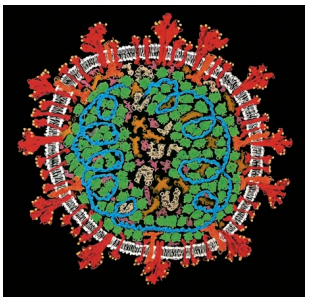
8. *Cell pump,* , acrylic marker on paper
11 x 8 5/8 inches, 16 x 15 inches matted
$1,800
Membranes are made of a double layer of fatty molecules (lipids, in white) in which proteins (red) are floating. This protein pumps hydrogen ions (H+), providing the metabolic energy the cell needs to live.



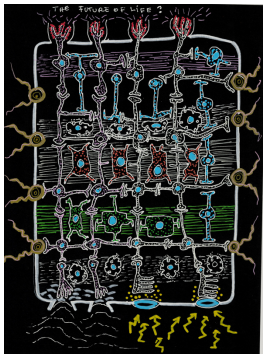
9. *AIDS virus,* 2021, acrylic marker on paper
8 1/4 x 8 1/4 inches, 11 7/8 x 11 3/8 inches matted
NFS
The AIDS virus is surrounded by a membrane (white). Proteins (red) protruding from this membrane attach to a cell membrane. The membranes fuse, letting genetic material from the virus (RNA in blue) enter and infect the cell.



10. *COVID virus,* 2021, acrylic marker on paper
8 1/4 x 8 1/4 inches, 11 7/8 x 11 3/8 inches matted
NFS
The COVID virus, like the AIDS virus, is surrounded by a membrane (white). Spike proteins (red) protrude from the viral membrane. They recognize receptor proteins in the membrane of cells they infect. Spike proteins promote the fusion of viral and cellular membranes. This causes genetic material from the virus (RNA in blue) to enter and re-program the infected cell in order to make multiple copies of the virus.



11. *Future of Life,* 2017, acrylic marker on paper
10 5/8 x 8 1/4 inches, 13 1/4 x 9 7/8 inches framed
$2,000
Networks of communicating cells grow and move on surface tracks of electronic circuits. In this way cells can be put to work on computer chips.



12. *Chromosomes,* 2018, acrylic marker on paper
10 5/8 x 8 1/4 inches, 13 1/4 x 9 7/8 inches framed
$2,000
Each chromosome is made of a long string of DNA coated and compacted by proteins. The tips of chromosomes called telomeres (dark blue) shorten as cells divide and age. Oldest chromosomes (top) have shortened telomeres and many mutations (coloured dots).

13. *Homunculus,* 2016, acrylic marker on paper
11 x 8 1/2 inches, 16 x 15 inches matted
NFS
Three centuries have passed since the Dutch scholar Nicholas Hartsoeker imagined that a tiny man - a "homunculus" - was huddled inside a human sperm cell. Since then, microscopes have revealed that a membrane (white) surrounds each sperm cell, and that it moves thanks to a flagellum powered by a mitochondria (red). The male chromosomes (blue) are located in the head of the sperm.

14. *LUCA – Last Universal Common Ancestor,* 2022, acrylic marker on paper
12 5/8 x 9 3/4 inches, 16 x 15 inches matted
NFS
A majority of researchers think that life originated at the bottom of the oceans about 4 billion years ago. Gases and metals oozing from microchambers in the abyss would have provided the necessary energy and molecules for the first cells to emerge. One of these protocells – LUCA (the Last Universal Common Ancestor) – gave rise to bacteria and archea – the single cell prokaryotes that evolved and colonized the entire planet.

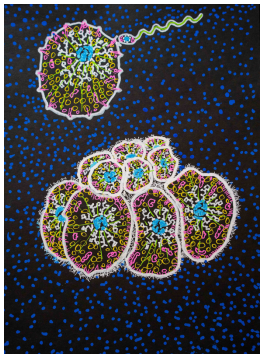
15. *From prokaryotes to eukaryotes,* 2021, acrylic marker on paper
12 7/8 x 9 3/4 inches, 16 x 15 inches matted
NFS
Prokaryote cells – bacteria (top left) and archaea (top right) – possess a single circular chromosome (blue). Eukaryote cells – protists, animals, fungi, algae and plants – have several linear chromosomes encased within a nuclear membrane. Membranes of bacteria, protists, animals, fungi, algae and plants are similar. But they are different from the membranes (yellow) of archea. Viruses that parasitize all cell types are shown in the background.

16. *Bacteria & archea,* 2021, acrylic marker on paper
12 3/4 x 9 3/4 inches, 16 x 15 inches matted
NFS
Bacteria (above) and archea (below) live as solitary cells or as colonies. Each cell is delimited by a membrane (white) and a protective wall (brown). Bacteria and archea are prokaryotes (without a nucleus), each possessing a single, circular chromosome (blue). Some species have appendages for movement. The molecules in membranes of archaea (yellow) are different from those of bacteria. Each species of bacteria and archaea has its own cohort of viruses called "phages" figured in the background.

17. *Biofilms,* 2017, acrylic marker on paper
11 x 8 1/2 inches, 16 x 15 inches matted
NFS
Microorganisms - bacteria, archaea and protists - form thick layers called biofilms. Within biofilms, cells exchange genes and secrete adhesive, protective molecules.

18. *A world of protists,* 2020, acrylic marker on paper
13 5/8 x 9 5/8 inches, 16 x 15 inches matted
NFS
Protists are eukaryotes – cells whose chromosomes are encased in a nucleus. They live as single cells, such as paramecia and dinoflagellates (bottom right). Some, for example diatoms, form colonies of identical cells. Others, such as volvocales (top left) include larger reproductive cells.

19. *Development,* 2017, acrylic marker on paper
10 5/8 x 8 1/4 inches, 16 x 15 inches matted
$1,800
The filiform sperm cell contains a nucleus with male chromosomes (blue), a mitochondrion (red organelles), microfilaments (red) and microtubules (green) in a flagellum. The larger spherical oocyte possesses a nucleus containing the female chromosomes (blue). At fertilization, the membranes (white) of sperm and oocyte fuse. The oocyte evolves into an embryo, a ball of dividing cells of different sizes and potentials that will develop into various tissues and organs.



20. *Holobionts & microbiomes,* 2020, acrylic marker on paper
13 1/2 x 9 3/4 inches, 16 x 15 inches matted
NFS
All animals, fungi, algae, and plants are holobionts – ecosystems made up of different partner organisms (called bionts). Each holobiont includes countless species of symbiotic and parasitic microorganisms (bacteria, archea, protists) constituting the microbiome.