References

- 1. Clyde A. Hutchison, III et al., <u>Design and synthesis of a minimal bacterial genome</u>. Science 351,aad6253(2016).DOI:10.1126/science.aad6253
- 2. Glass J., First Minimal Synthetic Bacterial Cell., J. Craig Venter Institute
- Shapson-Coe A, Januszewski M, Berger DR, et al. A petavoxel fragment of human cerebral cortex reconstructed at nanoscale resolution. Science. 2024;384(6696):eadk4858. doi:10.1126/science.adk4858
- 2. Alberts B, Johnson A, Lewis J, et al. Molecular Biology of the Cell. 4th edition. New York: Garland Science; 2002. Chromosomal DNA and Its Packaging in the Chromatin Fiber. Available from: https://www.ncbi.nlm.nih.gov/books/NBK26834/
- 3. Yang W, Yuste R. Brain maps at the nanoscale. Nat Biotechnol. 2019 Apr;37(4):378-380. doi: 10.1038/s41587-019-0078-2. PMID: 30872818; PMCID: PMC7053416.
- 4. Du B, Cheng X, Duan Y, Ning H. fMRI Brain Decoding and Its Applications in Brain-Computer Interface: A Survey. Brain Sci. 2022 Feb 7;12(2):228. doi: 10.3390/brainsci12020228. PMID: 35203991; PMCID: PMC8869956.
- 5. Card NS et al.. An Accurate and Rapidly Calibrating Speech Neuroprosthesis. N Engl J Med. 2024 Aug 15;391(7):609-618. doi: 10.1056/NEJMoa2314132. PMID: 39141853.
- 6. Oerlemans, R.a.J.F.; Timmermans, S.B.P.E.; Van Hest, J.C.M. <u>Artificial organelles:</u> Towards adding or restoring intracellular activity. ChemBioChem 2021, 22, 2051–2078.
- 7. Wang, J., Zhao, M., Wang, M. *et al.* <u>Human neural stem cell-derived artificial organelles to improve oxidative phosphorylation</u>. *Nat Commun* 15, 7855 (2024). https://doi.org/10.1038/s41467-024-52171-2
- 8. Santinho, A., Carpentier, M., Lopes Sampaio, J. et al. <u>Giant organelle vesicles to uncover intracellular membrane mechanics and plasticity</u>. *Nat Commun* 15, 3767 (2024). https://doi.org/10.1038/s41467-024-48086-7
- 9. Tian, F., Zhou, Y., Ma, Z., Tang, R., & Wang, X. (2024). <u>Organismal Function Enhancement through Biomaterial Intervention</u>. Nanomaterials, 14(4), 377. https://doi.org/10.3390/nano14040377
- 10. Herculano-Houzel S. The human brain in numbers: a linearly scaled-up primate brain. Front Hum Neurosci. 2009;3:31. Published 2009 Nov 9. doi:10.3389/neuro.09.031.2009
- 11. Jinek M, Chylinski K, Fonfara I, Hauer M, Doudna JA, Charpentier E. A programmable dual-RNA-guided DNA endonuclease in adaptive bacterial immunity. *Science*. 2012;337(6096):816-821. doi:10.1126/science.1225829
- 12. Yang, Y., DeWeese, M. R., Otazu, G. H. & Zador, A. M. Millisecond-scale differences in neural activity in auditory cortex can drive decisions. *Nat. Neurosci.* 11, 1262–1263 (2008).
- 13. von Bartheld CS. Myths and truths about the cellular composition of the human brain: A review of influential concepts. J Chem Neuroanat. 2018 Nov;93:2-15.

- doi: 10.1016/j.jchemneu.2017.08.004. Epub 2017 Sep 2. PMID: 28873338; PMCID: PMC5834348.
- 14. Kaposzta Z, Stylianou O, Mukli P, Eke A, Racz FS. Decreased connection density and modularity of functional brain networks during n-back working memory paradigm. Brain Behav. 2021;11(1):e01932. doi:10.1002/brb3.1932
- 15. Tomasi D, Volkow ND. Functional connectivity density mapping. Proc Natl Acad Sci U S A. 2010;107(21):9885-9890. doi:10.1073/pnas.1001414107
- 16. Stanley S. Biological nanoparticles and their influence on organisms. Curr Opin Biotechnol. 2014;28:69-74. doi:10.1016/j.copbio.2013.11.014
- 17. Herculano-Houzel S. <u>The human brain in numbers: a linearly scaled-up primate brain</u>. <u>Front Hum Neurosci</u>. 2009;3:31. Published 2009 Nov 9. doi:10.3389/neuro.09.031.2009
- 18. Wheeler, M., Smith, C., Ottolini, M. et al. Genetically targeted magnetic control of the nervous system. Nat Neurosci 19, 756–761 (2016). https://doi.org/10.1038/nn.4265
- 19. Zhao C, Wang Y, Nie X, et al. Evaluation of the effects of sequence length and microsatellite instability on single-guide RNA activity and specificity. Int J Biol Sci. 2019;15(12):2641-2653. Published 2019 Oct 3. doi:10.7150/ijbs.37152
- 20. Klinshov VV, Teramae JN, Nekorkin VI, Fukai T. Dense neuron clustering explains connectivity statistics in cortical microcircuits. PLoS One. 2014;9(4):e94292. Published 2014 Apr 14. doi:10.1371/journal.pone.0094292
- 21. https://pmc.ncbi.nlm.nih.gov/articles/PMC9183966/
- 22. https://pmc.ncbi.nlm.nih.gov/articles/PMC8538656/
- 23. https://brainmuseum.org/
- 24. https://en.wikipedia.org/wiki/Neuron
- 25. https://en.wikipedia.org/wiki/Cas9#:~:text=In%20practice%2C%20CRISPR%2 FCas%20systems,24%20and%2048%20nucleotides%20long.
- 26. https://en.wikipedia.org/wiki/Nerve_tract
- 27. Le Duigou C, Simonnet J, Teleñczuk MT, Fricker D, Miles R. Recurrent synapses and circuits in the CA3 region of the hippocampus: an associative network. *Front Cell Neurosci.* 2014;7:262. Published 2014 Jan 8. doi:10.3389/fncel.2013.00262
- 28. Sammons RP, Vezir M, Moreno-Velasquez L, et al. Structure and function of the hippocampal CA3 module. *Proc Natl Acad Sci U S A*. 2024;121(6):e2312281120. doi:10.1073/pnas.2312281120

- 29. Hunt, D.L., Linaro, D., Si, B. *et al.* A novel pyramidal cell type promotes sharp-wave synchronization in the hippocampus. *Nat Neurosci* 21, 985–995 (2018). https://doi.org/10.1038/s41593-018-0172-7
- Wiera G, Mozrzymas JW. Extracellular proteolysis in structural and functional plasticity of mossy fiber synapses in hippocampus. Front Cell Neurosci. 2015;9:427. Published 2015 Nov 4. doi:10.3389/fncel.2015.00427
- 31. https://www.nature.com/subjects/cellular-neuroscience
- 32. https://www.nature.com/subjects/neural-circuit
- 33. Fujise, K., Mishra, J., Rosenfeld, M.S. et al. Synaptic vesicle characterization of iPSC-derived dopaminergic neurons provides insight into distinct secretory vesicle pools. npj Parkinsons Dis. 11, 16 (2025). https://doi.org/10.1038/s41531-024-00862-4
- 34. Lee B, White KI, Socolich M, et al. Direct visualization of electric-field-stimulated ion conduction in a potassium channel. Cell. 2025;188(1):77-88.e15. doi:10.1016/j.cell.2024.12.006
- 35. Alonso, N., Krichmar, J.L. A sparse quantized hopfield network for online-continual memory. Nat Commun 15, 3722 (2024). https://doi.org/10.1038/s41467-024-46976-4
- 36. Predictive Sequence Learning in the Hippocampal Formation. https://www.biorxiv.org/content/10.1101/2022.05.19.492731v3.full.
 - Predictive Sequence Learning in the Hippocampal Formation. Yusi Chen, Huanqiu Zhang, Mia Cameron, Terrrence Sejnowski. bioRxiv 2022.05.19.492731; doi: https://doi.org/10.1101/2022.05.19.492731
- 37. Alonso, N., Krichmar, J.L. A sparse quantized hopfield network for online-continual memory. Nat Commun 15, 3722 (2024). https://doi.org/10.1038/s41467-024-46976-4
- 38. Insel N, Takehara-Nishiuchi K. The cortical structure of consolidated memory: a hypothesis on the role of the cingulate-entorhinal cortical connection. Neurobiol Learn Mem. 2013;106:343-350. doi:10.1016/j.nlm.2013.07.019
- 39. Woolnough O, Donos C, Rollo PS, et al. Spatiotemporal dynamics of orthographic and lexical processing in the ventral visual pathway. Nat Hum Behav. 2021;5(3):389-398. doi:10.1038/s41562-020-00982-w
- 40. Kong, X., Kong, R., Orban, C. et al. Sensory-motor cortices shape functional connectivity dynamics in the human brain. Nat Commun 12, 6373 (2021). https://doi.org/10.1038/s41467-021-26704-y
- 41. Ponce-Alvarez, A., Deco, G. The Hopf whole-brain model and its linear approximation. Sci Rep 14, 2615 (2024). https://doi.org/10.1038/s41598-024-53105-0

- 42. Cooray GK, Cooray V, Friston K. A cortical field theory dynamics and symmetries. J Comput Neurosci. 2024;52(4):267-284. doi:10.1007/s10827-024-00878-y
- 43. Rădulescu, A., Herron, J., Kennedy, C. et al. Global and local excitation and inhibition shape the dynamics of the cortico-striatal-thalamo-cortical pathway. Sci Rep 7, 7608 (2017). https://doi.org/10.1038/s41598-017-07527-8
- 44. Rueda-Castro V, Azofeifa JD, Chacon J, Caratozzolo P. Bridging minds and machines in Industry 5.0: neurobiological approach. Front Hum Neurosci. 2024;18:1427512. Published 2024 Aug 27. doi:10.3389/fnhum.2024.1427512
- 45. Vaz AP, Wittig JH Jr, Inati SK, Zaghloul KA. Replay of cortical spiking sequences during human memory retrieval. Science. 2020;367(6482):1131-1134. doi:10.1126/science.aba0672
- 46. R.B. Yaffe, M.S.D. Kerr, S. Damera, S.V. Sarma, S.K. Inati, K.A. Zaghloul, Reinstatement of distributed cortical oscillations occurs with precise spatiotemporal dynamics during successful memory retrieval, Proc. Natl. Acad. Sci. U.S.A. 111 (52) 18727-18732, https://doi.org/10.1073/pnas.1417017112 (2014).
- 47. Yaffe, R. B., Shaikhouni, A., Arai, J., Inati, S. K., & Zaghloul, K. A. (2017). Cued Memory Retrieval Exhibits Reinstatement of High Gamma Power on a Faster Timescale in the Left Temporal Lobe and Prefrontal Cortex. The Journal of neuroscience: the official journal of the Society for Neuroscience, 37(17), 4472–4480.
- 48. Davidson, T. J., Kloosterman, F., & Wilson, M. A. (2009). Hippocampal replay of extended experience. Neuron, 63(4), 497–507. https://doi.org/10.1016/j.neuron.2009.07.027
- 49. Huelin Gorriz, M., Takigawa, M. & Bendor, D. The role of experience in prioritizing hippocampal replay. Nat Commun 14, 8157 (2023). https://doi.org/10.1038/s41467-023-43939-z
- 50. Graham Findlay, Giulio Tononi, Chiara Cirelli, The evolving view of replay and its functions in wake and sleep, SLEEP Advances, Volume 1, Issue 1, 2020, zpab002, https://doi.org/10.1093/sleepadvances/zpab002

Additional References:

- Jinek M, Chylinski K, Fonfara I, Hauer M, Doudna JA, Charpentier E. A programmable dual-RNA-guided DNA endonuclease in adaptive bacterial immunity. Science. 2012 Aug 17;337(6096):816-21. doi: 10.1126/science.1225829. Epub 2012 Jun 28. PMID: 22745249; PMCID: PMC6286148.
- 2. Nature news | Wi-Fi for neurons: first map of wireless nerve signals unveiled in worms: https://www.nature.com/articles/d41586-023-03619-w
- 3. Insanally, M.N., Albanna, B.F., Toth, J. et al. <u>Contributions of cortical neuron firing patterns, synaptic connectivity, and plasticity to task performance</u>. *Nat Commun* 15, 6023 (2024). https://doi.org/10.1038/s41467-024-49895-6
- 4. "Human Brain cellular composition (demythed)": von Bartheld CS. Myths and truths about the cellular composition of the human brain: A review of influential concepts. J Chem Neuroanat. 2018 Nov;93:2-15. doi: 10.1016/j.jchemneu.2017.08.004. Epub 2017 Sep 2. PMID: 28873338; PMCID: PMC5834348.
- 5. "Measure the absorbance of Cas9 protein at 280 nm using a NanoDrop Lite spectrophotometer."
 - https://pmc.ncbi.nlm.nih.gov/articles/PMC9183966/
- 6. Stanley S. <u>Biological nanoparticles and their influence on organisms</u>. Curr Opin Biotechnol. 2014 Aug;28:69-74. doi: 10.1016/j.copbio.2013.11.014. Epub 2014 Jan 8. PMID: 24832077.
 - Biological nanoparticles and their influence on organisms:
 "A naturally occurring nanoparticle is an assembly of molecules or atoms, synthesized in a biological system, with at least one dimension in the 1–100 nm range. These particles include intracellular structures such as magnetosomes and extracellular assemblies such as lipoproteins and viruses."
 - https://www.sciencedirect.com/science/article/abs/pii/S0 958166913007155
- 7. Kaposzta Z, Stylianou O, Mukli P, Eke A, Racz FS. Decreased connection density and modularity of functional brain networks during n-back working memory paradigm. Brain Behav. 2021 Jan;11(1):e01932. doi: 10.1002/brb3.1932. Epub 2020 Nov 13. PMID: 33185986; PMCID: PMC7821619.
- 8. https://pubmed.ncbi.nlm.nih.gov/24732632/
- 9. https://www.nature.com/articles/s41467-019-09515-0
- 10. https://www.sciencedirect.com/science/article/pii/S2211124722004296

- 11. https://biologicalsciences.uchicago.edu/news/simple-model-brain-cells-connect#">https://biologicalsciences.uchicago.edu/news/simple-model-brain-cells-connect##">https://biologicalsciences.uchicago.edu/news/simple-model-brain-cells-connect### #:~:text=Understanding%20how%20neurons%20connect,are%20much%20stronger%20than%20most.
- 12. https://www.nature.com/articles/s41467-024-52171-2
- 13.Biological nanoparticles and their influence on organisms, science direct:

 https://www.sciencedirect.com/science/article/abs/pii/S0958166913
 007155
- 14. Ferritin nanocages: A biological platform for drug delivery, imaging and theranostics in cancer
- 15. Recent progress in targeted delivery vectors based on biomimetic nanoparticles | Signal Transduction and Targeted Therapy, https://www.nature.com/articles/s41392-021-00631-2
- 16. Wheeler, M., Smith, C., Ottolini, M. et al. Genetically targeted magnetic control of the nervous system. *Nat Neurosci* 19, 756–761 (2016). https://doi.org/10.1038/nn.4265
- 17. Nature Signal Transduction and Targeted Therapy: https://www.nature.com/sigtrans/
- 18. Tomasi D, Volkow ND. Functional connectivity density mapping. Proc Natl Acad Sci U S A. 2010;107(21):9885-9890. doi:10.1073/pnas.1001414107
- 19. Micrometer figure:
 https://pubmed.ncbi.nlm.nih.gov/38723085/#&gid=article-figures&pi
 d=figure-5-uid-4
- 20. https://en.wikipedia.org/wiki/Four color theorem
- 21. Brain Maps at nanoscale | PubMed | https://pubmed.ncbi.nlm.nih.gov/30872818/
 - Similar articles:
 - In Situ Nanoscale Redox Mapping Using Tip-Enhanced Raman Spectroscopy., Kang G, Yang M, Mattei MS, Schatz GC, Van Duyne RP., Nano Lett. 2019 Mar 13;19(3):2106-2113. doi: 10.1021/acs.nanolett.9b00313. Epub 2019 Feb 19., PMID: 30763517
 - Nanoscale friction and wear maps., Tambe NS, Bhushan B., Philos Trans A
 Math Phys Eng Sci. 2008 Apr 28;366(1869):1405-24. doi:
 10.1098/rsta.2007.2165., PMID: 18156128
 - In situ nanoscale mapping of the chemical composition of surfaces and
 3D nanostructures by photoelectron spectromicroscopy., Ratto F, Heun S,

- Moutanabbir O, Rosei F., Nanotechnology. 2008 Jul 2;19(26):265703. doi: 10.1088/0957-4484/19/26/265703. Epub 2008 May 20., PMID: 21828691
- Global order and local disorder in brain maps., Rothschild G, Mizrahi A.,
 Annu Rev Neurosci. 2015 Jul 8;38:247-68. doi:
 10.1146/annurev-neuro-071013-014038. Epub 2015 Apr 9., PMID:
 25897872 Review.
- Self-organizing maps for internal representations., Ritter H., Psychol Res.
 1990;52(2-3):128-36. doi: 10.1007/BF00877520., PMID: 2281125 Review.
- Borah BJ, Sun CK. <u>A rapid denoised contrast enhancement method</u>
 digitally mimicking an adaptive illumination in submicron-resolution
 neuronal imaging. *iScience*. 2022;25(2):103773. Published 2022 Jan 15.
 doi:10.1016/j.isci.2022.103773
- Thermoelectric porous laser-induced graphene-based strain-temperature
 decoupling and self-powered sensing: The authors design the stretchable
 thermoelectric porous graphene foam-based materials via facile laser scribing,
 demonstrating decoupled sensing of strain and temperature during the wound
 healing process in situ., Li Yang, Xue Chen, Huanyu Cheng
- Hancock, F., Rosas, F.E., Luppi, A.I. et al. Metastability demystified the foundational past, the pragmatic present and the promising future. Nat. Rev. Neurosci. 26, 82–100 (2025).
 https://doi.org/10.1038/s41583-024-00883-1
- https://www.nature.com/subjects/biophysical-models
- Immune evasion through mitochondrial transfer in the tumour microenvironment. Nature (2025)
- Liu, J., Jiang, C., Yu, Q. et al. Multidimensional free shape-morphing flexible neuromorphic devices with regulation at arbitrary points. Nat Commun 16, 756 (2025). https://doi.org/10.1038/s41467-024-55670-4
 Electronic devices, Electronic properties and materials