Prof. Joseph T.Y. Wong Laboratory

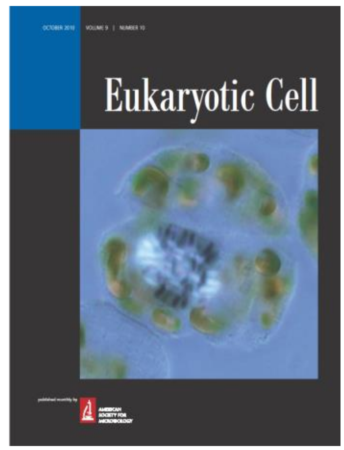
Cellular growth concordance with membrane-lipid axis, cellulose deposition, and genome physical karyotypes

Many dinoflagellate cells are large, with nuclear size large than a yeast cell, and a chromosome larger than a bacteria (!!) ---------- they are not merely good looking and full of energy (try Blue tears) https://www.youtube.com/watch?v=uUhBGeMp_JY

And are very Green---being the group that produced the highest greenhouse negative compound DMSP/DMS https://academic.oup.com/nsr/article/8/2/nwaa140/5861306

The Wong Lab utilizes yeast, bacteria, and dinoflagellate cells to address major problems in biology, as well as enlightening the undervalued system to biotechnology.

Liquid Crystalline Chromosomes: Phase Transitions and Self-Assembly. Under high concentrations and strong volume depletion force, aqueous DNAs can form liquid crystalline phases. Biophysical studies suggested highly anisotropic organization, manifested as strong birefringence in dinoflagellates Liquid Crystalline Chromosomes (LCCs), which some of the largest-eukaryotic genomes (up to 80 times human genome size) but counter-intuitively had no detectable nucleosomes. Dinoflagellate histone-like proteins, which bear no relationship with core histones (Wong et al., 2003), organized DNAs in a concentration-dependent manner, including looping of DNAs and phase transitional events (Chan et al., 2007). Nuclear genome dynamics, and the architectural organization of tandem repeat arrays, need to be orchestrated with DNA damage responses.



Yan, KHT, Ng, CN, Kwok, ACM, and Wong, JTY (2020) Knockdown of dinoflagellate condensin CcSMC4 subunit led to S-phase impediment and decompaction of liquid crystalline chromosomes. ***Microorganism***

Wong JTY (2019) Architectural organization of dinoflagellate liquid crystalline chromosomes. ***Microorganism*** 7: 27 doi:10.3390/microorganisms7020027

Sun S, Wong JTY, Liu M, and Dong F. (2012) Counterion-mediated decompaction of liquid crystalline chromosomes. ***DNA Cell Biol***. 12:1657-64.

Chan, Y.H. and Wong, JTY (2007) Concentration-dependent organization of DNA by the dinoflagellate histone-like protein HCc3. ***Nucleic Acid Research*** 35:2573-2583.

Chow, MH, Yan, KTH, Bennett, MJ, and **Wong JTY** (2010) Liquid Crystalline Chromosomes: Birefringence and DNA Condensation. ***Eukaryotic Cell*** 9:1577-1587.

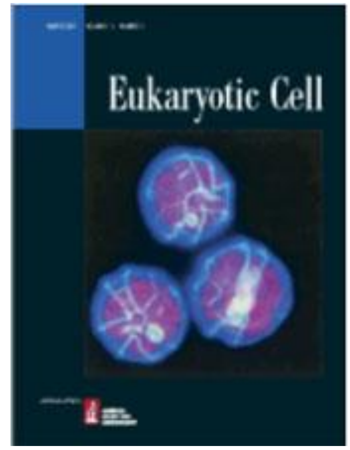
Fojtová,M, Wong JTY, Dvořáčková, M, Yan, KTH, Sýkorová, E and Fajkus J (2010) Telomere maintenance in liquid crystalline chromosomes of dinoflagellates. ***Chromosoma*** [Epub: DOI: 10.1007/s00412-010-0272-y

Mak CKM, Hung VKL, and Wong JTY (2005) Type II Topoisomerase activities in both G1 and G2/M phases of the dinoflagellate cell cycle. ***Chromosoma*** 114:420-431

Wong, JTY, New DC, Wong JCW, and Hung, VKL (2003) The Dinoflagellate Basic Chromosomal Proteins (HCCs) have homologies to bacterial DNA-binding proteins. ***Eukaryotic Cell*** 2:646-650.

Cellulosic Thecal Plates and Cellulose Synthesis: Crystallinity and Coordination with Cellular Growth

Cellulose is the most abundant biopolymer on earth. Thecate dinoflagellates are well known for their ability to produce intricate cellulosic thecal plates (CTPs), which are intracellular and three-dimensional, contrasting with extracellular and two-dimensional nature of plant cell wall. CTPs also have the hardness of wood (plant secondary cell wall) without requirement of lignin fortification. CTP formation encompasses carbon fixation, cellulose biogenesis, vesicular transport rate, quantatative Ca^{2+}-membrane interactomes, optical biology, and spatial-temporal volume depletion force axis, in addition to dinoflagellate modelling in circadian rhythm, peridinin photobiology, and toxin biosynthesis; their developments with the ongoing genetic dissection and genome annotations will put amphiesma-CTP explorations at cross-forefronts between physical biology, biochemistry, synthetic biology, and molecular biology.



Kwok, A.C.M., Chan, W.S. and Wong, J.T.Y. (2023) Dinoflagellate Amphiesma: Cellular Growth and Ecdysial dynamics. ***Marine Drugs*** *21*(2), 70; **https://doi.org/10.3390/md21020070**

Chan WS, Kwok ACM, Wong JTY (2019) Knockdown of dinoflagellate cellulose synthase CesA1 resulted in malformed intracellular cellulosic thecal plates and severely impeded cyst-to-swarmer transition. ***Frontiers in Microbiology*** 10: 546. 1010.3389/fmicb.2019.00546

Kwok ACM and Wong JTY (2010) Activities of a walled-bound cellulase is coupled to and is required for cell cycle progression in a dinoflagellate. ***Plant Cell*** 22:1281-1298

Kwok ACM, Mak CKM, Wong, FTW, and Wong JTY (2007) A novel method for the preparation of protoplasts from cells with internal cellulosic thecal plates. ***Eukaryotic Cell*** 6:563-567.

Lau RKL, Kwok, ACM, Chan, WK, Zhang TY, and Wong JTY (2006) Mechanical characterization of cellulosic thecal plates in dinoflagellates by nanoindentation. ***Journal of Nanoscience and Nanotechnology*** 7: 451-457

Kwok ACM and **Wong JTY** (2003) Cellulose synthesis is coupled to cell cycle progression at g_1 in the dinoflagellate *Crypthecodinium cohnii*. ***Plant Physiology*** 131:1681-1691.

Cellular Growth concordance

Cellular growth are regulated within a small range in response to prevailing nutritional status in most unicell. Wall polyssacharides and membranes increased non-stochastically with cellular growth progression, (Kwok and Wong, 2003, 2005). Under nutritional shift-up conditions, a growth-dependent cyclic ADP-ribose transient as the switch between binary versus multiple fission (Lam et al., 2009,); it was one of the few cases in which a growth-rate signal at G_1 was biochemically linked to G_1-G_2 growth control. In microplanktons, cell size affect buoyancy, sinking rates, cell harvesting and ecological niche.

Lam CMC, Yeung, PKK, Lee, HC, and Wong JTY (2009) Cyclic ADP-ribose links metabolism to multiple fission in the dinoflagellate Crypthecodinium cohnii. Cell Calcium 45: 346–357

Kwok, ACM, Zhang, F., Ma, Z, Chan, WS, Yu, VC. Tsang, JSH, Wong JTY (2020) Functional responses between PMP3 small membrane proteins and membrane potential. Environ Microbiol. doi: 10.1111/1462-2920.15027.

Lam CMC., New,D.C. and Wong J.T.Y. (2009) cAMP in the cell cycle of the dinoflagellate *Crypthecodinium cohnii* (Dinophyta) ***Journal of Phycology*** 37(1):79 - 85

Yeung, PKK, Lam, CMC, Ma, ZY, and Wong JTY (2006) Involvement of calcium mobilization from caffeine-sensitive stores in mechanically induced cell cycle arrest in the dinoflagellate *Crypthecodinium cohnii*. ***Cell Calcium*** 39:259-274

Kwok ACM and Wong JTY (2005) Lipid biosynthesis and its coordination with cell cycle progression. ***Plant & Cell Physiology*** 12:1973-1986.

Wong JTY and Kwok ACM (2005) Proliferation of Dinoflagellates: Blooming or Bleaching. ***BioEssays*** 27: 730-740.

Kwok ACM and Wong JTY (2003) Cellulose synthesis is coupled to cell cycle progression at G_1 in the dinoflagellate *Crypthecodinium cohnii*. ***Plant Physiology*** 131:1681-1691

Chan, KL, D. New, D, Ghandhi, S, Wong, F, Lam, CMC, and Wong JTY (2002) Transcript levels of the Eukaryotic Initiation Factor 5A gene peak at early G1 phase of the cell cycle in the dinoflagellate *Crypthecodinium cohnii*. ***Applied and Environmental Microbiology***: 68: 2278-

DNA Damage Responses, Genome changes, and Biotechnology

DNA damage responses (DDRs) are not only important in cancer biology and environmental biology but are intrinsic to all cells (and likely virus-host relationship) for survival, and for chromosomal operations (e.g. telomere biology). The adoption of DDRs and responses to invasive nucleic acids will be keys to developing next-generation mutagenesis and recombinant DNA technology.

With non-nucleosomal genome architecture and tandem-repeat encoding, and no nuclear envelope breakdown, the system is well poised for addressing major questions in evolution. Many species produce bioactive compounds (and mucus traps !), including DMSP/DMS, carotenoids, and DHA in relative high concentrations. With the development of genetic transformation systems and published genomes, it is a strategic time in studying dinoflagellates. We are developing the group, and particularly a small genome size dinoflagellate, as a model system for cell biology and synthetic biology.

Kwok A.C.M., Law, S. and Wong, JTY (2023) The oleaginous genus Crypthecodinaceae. **Marine Drugs**

Kwok, ACM, Li C., Lam,W.T. and Wong JTY (2022) DNA damage responses in dinoflagellates. ***Environmental Microbiology***

Li C and Wong JTY (2019) DNA damage response pathways in Dinoflagellates. ***Microorganism*** 7: 191

Leung, S.K. and Wong, J.T.Y. (2009) The Replication of Plastid Minicircles Involves Rolling Circle Intermediates. ***Nucleic Acids Research*** 37: 1991-2002.

Kai, AKL, Cheung, YK, Yeung PKK, and Wong JTY (2006) Development of single-cell PCR methods for the Raphidophyceae. ***Harmful Algae*** 5:649-

Yeung PKK, Wong, FTW, and Wong JTY (2002) Mimosine, the allelochemical from Lucaena, selectively stimulates cell proliferation in dinoflagellates. ***Applied and Environmental Microbiology*** 68:5160-5163. United States Patent **(**No.7,396,672 B2**)**

Yeung, PKK, Wong, FTW and Wong JTY (1996) Sequence data of two small subunit ribosomal RNA for a South China strain of *Alexandrium catenella*. ***Applied and Environmental Microbiology*** 62:4199-4201.