**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 larger 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](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](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*


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

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\textsuperscript{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 ACM and Wong JTY (2003) Cellulose synthesis is coupled to cell cycle progression at g\textsubscript{1} in the dinoflagellate Cryptothecodinium 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 polysaccharides 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\textsubscript{1} was biochemically linked to G\textsubscript{1}-G\textsubscript{2} growth control. In microplanktons, cell size affect buoyancy, sinking rates, cell harvesting and ecological niche.


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


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


United States Patent (No.7,396,672 B2)