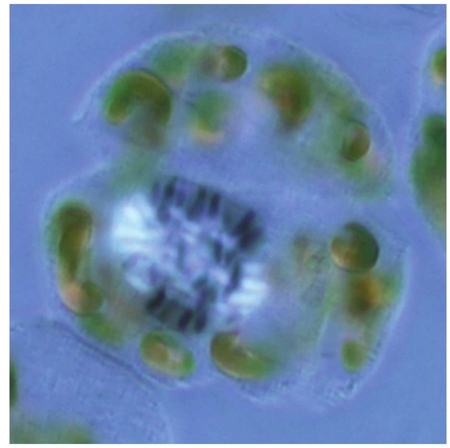
Quasi-Condensed DinoChromosomes

Phase Transitions and Self-Assembly constitute a major axis in nuclear transactions. Biophysical studies suggested highly anisotropic organized domains, manifested as strong birefringence when observed under polarizing light in dinoflagellates Quasi-condensed chromosomes (QCCs). DNA damage-response is a common biomedical theme, as well as probing genome architectures, uniting our understanding and pursuits of genome integrity. QCCs had no canonical architectural nucleosomes and have the lowest known chromosomal protein-to-DNA ratios in extant eukaryotes. Their histone-like proteins, which belong to the linker histone super family histones, organized DNAs in a concentration-dependent manner, including charge reversal and phase transition of the nucleic acid-protein condensates.



Birefringent photomicrograph of Karenia Chromosome visualization without staining

Kwok, A.C.M., Li, C., Lam, W.T., and Wong, J.T.Y. (2022) Responses of dinoflagellate cells to ultraviolet-C irradiation. *Environ Microbiol0gy*

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

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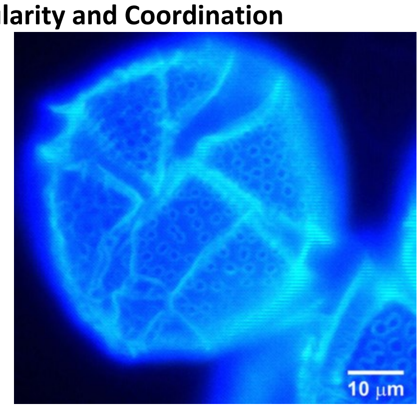
Cellulosic Thecal Plates and Cellulose Synthesis: Crystallinity, Modularity and Coordination

Cellulose is the most abundant biopolymer on earth, their synthesis and hydrolysis are the platform technology in multiple industries, including wine, paper, biomedical and textile. Thecate dinoflagellates are well known for their ability to produce intricate cellulosic thecal plates (CTPs), which are intracellular and three-dimensional, contrast with extracellular and two-dimensional nature of plant cell wall. CTPs are deposited in precision arrangement with very fine fibers and with the hardness of wood. We are interested in the biosynthesis-deposition of CTPs and its potential biotechnological application. With dinoflagellates being the major algal bloom agents, and the major producers of the carbon negative DMS/DMSP, CTPs are potential next generation green source of cellulose.



Fluorescence photomicrograph of Cellulosic Thecal Plates in a *Lingulodinium polyedrum* cell.

Chan, W.S., Kwok, A.C.M., and Wong, J.T.Y. (2019) Knockdown of Dinoflagellate Cellulose Synthase *CesA1* Resulted in Malformed Intracellular Cellulosic Thecal Plates and Severely Impeded Cyst-to-Swarmer Transition. *Front Microbiol* **10**: 546.

Kwok, A.C.M., and Wong, J.T.Y. (2010) The activity of a wall-bound cellulase is required for and is coupled to cell cycle progression in the dinoflagellate *Crypthecodinium cohnii*. *Plant Cell* **22**: 1281-1298.

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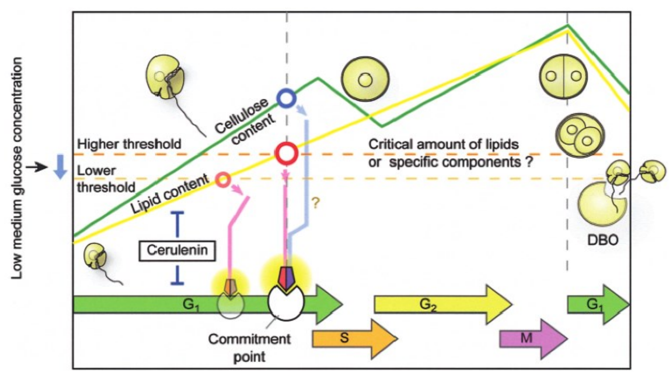
Kwok, A.C.M., and Wong, J.T.Y. (2003) Cellulose synthesis is coupled to cell cycle progression at G_1 in the dinoflagellate *Crypthecodinium cohnii*. *Plant Physiol* **131**: 1681-1691.

Growth concordance in genome-growth cycle

Theoretical considerations of cellular growth



Cellular growth and genome cycles have different operatives, permeated to all macromolecular synthesis and deposition, in the context of resource availability and trending. Cellular growth homeostasis is not only an intriguing philosophical concept, but have both applied and biomedical applications, commonly recognized in cancer biology, but factually affecting all biological processes. In dinoflagellates, growth-genome cycles feature prominently in coral-zooxanthellae relationship, affecting bioactive compound production, cell proliferation rates in algal blooms, niche in the ecosystem and global productivity. Polysaccharide and membrane deposition increased non-stochastically with genome progression, reflecting coordination between growth and deposition, the mechanisms of which are little explored.

Kwok, A.C.M., Zhang, F., Ma, Z., Chan, W.S., Yu, V.C., Tsang, J.S.H., and Wong, J.T.Y. (2020) Functional responses between PMP3 small membrane proteins and membrane potential. *Environ Microbiol* **22**: 3066-3080.
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Sun, S., Yin, G., Lee, Y.-K., Wong, J.T.Y.**,** T.Y. Zhang (2011) Effects of deformability and thermal motion of lipid membrane on electroporation: By molecular dynamics simulations. Biochemical and Biophysical Research Communications 404: 684-688.
Sheng Sun, Wong, J.T.Y., and T.Y.Zhang (2011) Molecular dynamics simulations of phase transition of lamellar lipid membrane in water under an electric field. Soft Matter 7: 147-152.

Research lifestyle is not for everybody, with dedication, diligence, and intelligence being the basic requirements. The joy of knowledge and empirical thinking are human intrinsic ability, to different degrees at different stages of formation, most often requiring guidance for maturation. Basic science involves multiple stage-dependent abstract modeling of the unknown, with creativity, intuition, connections, realization, and educated judgement; most often applied sciences involve the innovative mind to solve problems, both are crucial for the future. The training of MPhil/PhD involves a passage to independent scientists in the journey of long-term commitment. In addition to designing and doing experiments, reading papers, and writing your own, to contribute new scientific knowledge. Scientists are commonly judged by our competitors, either in manuscript reviewing or in grant application; not for those with faint stomach and heart. If English is not your first language, it will likely take longer. Most PG students, especially those without prior training in dinoflagellates, go through the MPhil-PhD stream (2+3) model, to secure full-time funding and in empirical thinking.

Biofuels, bioactive compounds, and microalgal lipids.

With COP28, the world is griping with renewed drives for biofuels and carbon-minus carbon sequestrations, with the pledge of replacing fossil fuel. Since the 1970, 'algal oil(s)' have been in the limelight as a potential fuel, especially 'microalgae'. Without scientific definition for 'microalgae'.
'Microalgae' ARE NOT hydroponics and are prone to be contamination (e.g. bacteria and yeasts), which will potentially affect the product safety. Our proposals are for different microalgae for assisted carbonate deposition, with synthetic biology of microalgae producing oil, based on different biochemical profiles of the different groups. Regulatory agencies are increasingly stringent in the taxonomic source (reproducibility) of microalgal oil.

Our focus is on oleaginous dinoflagellates**.** Pyrolysis of ancient carbon, including those of dinoflagellate wall lipid components (which are highly chemical resistant, e.g. dinosporin) contributed to the formation of fossil fuels. It is perhaps not a coincidence that current dinoflagellates behold some of the highest oil content (with different polar/apolar lipid ratios) with the highest carbon negative content of DMSP/DMS at the same time. Carbon footprint analysis will be subjected to independent adjustor, and not just a green color cover.
Previous 'blooms and bust' have led to bad names for algal biofuel.
https://www.greentechmedia.com/articles/read/lessons-from-the-great-algae-biofuel-bubble#amp_tf=From%20%251%24s&aoh=17010419526328&referrer=https%3A%2F%2Fwww.google.com&ampshare=https%3A%2F%2Fwww.greentechmedia.com%2Farticles%2Fread%2Flessons-from-the-great-algae-biofuel-bubble
https://www.nytimes.com/2014/05/31/business/biofuel-tools-applied-to-household-soaps.html
https://www.theguardian.com/environment/2023/mar/17/big-oil-algae-biofuel-funding-cut-exxonmobil
Take home message: Algae 1 is not the same as algae 2, incubators can be difficult to be cleaned.

Oleaginous Heterotrophic Dinoflagellates-Crypthecodiniaceae
https://www.mdpi.com/1660-3397/21/3/162
The heterotrophic *Crypthecodinium cohnii* is a major model for dinoflagellate cell biology, and a major industrial producer of docosahexaenoic acid (DHA), a key nutraceutical and added pharmaceutical compound. Despite their biotechnological significances, with different strains deployed for DHA production supplement in infant formulas, the family Crypthecodiniaceae was not fully described, which is partly attributable to their degenerative thecal plates, as well as the lack of ribotype-referred morphological description in many taxons. We isolated a series of novel species and described *Crypthecodinium croucherii* sp. nov. Kwok, Law, and Wong, which have different genome sizes, ribotypes, and amplification fragment length polymorphism profiles when compared to the *C. cohnii*. (Nile Red staining polar lipids in *C.cohnii*)

We are progressively completing analysis, including genome analysis, of our new species collections and will make strains available per biotechnological requests.

There are several carbonate-producing dinoflagellates that have cellular biomass-carbonate exceeding those of the coccolithophorids per cell, and we have mastered synchronization method for investigating the molecular process of HCO_3^- concentration, intercellular transport-pre-formation, and subcellular-cortical-surface carbonate deposition.