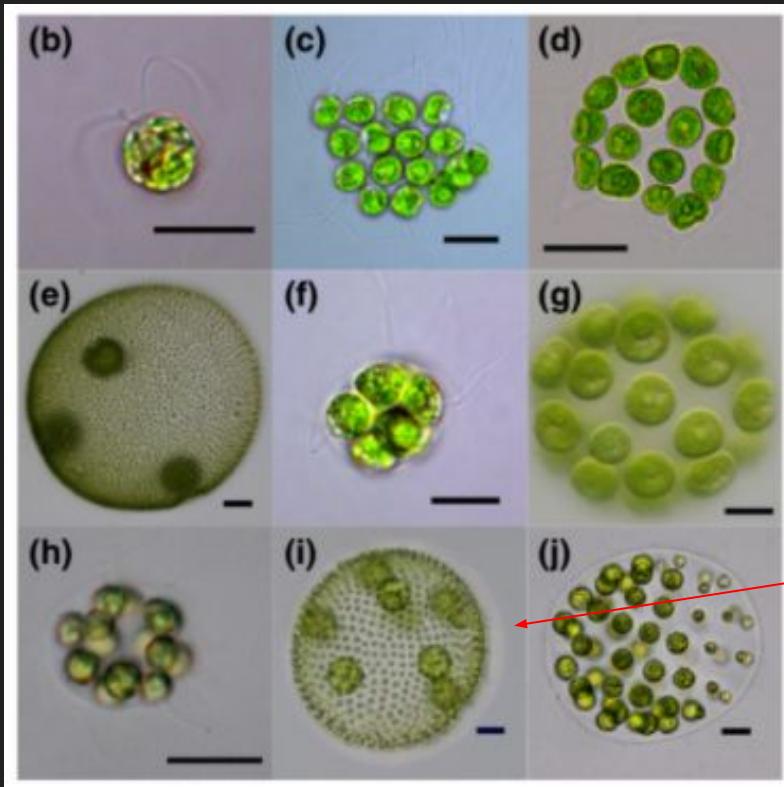


Chloroplast Nucleoid Proteins and their Proposed Role in *Volvox powersii* Cellular Differentiation

Zack Bishop
Dr. Gochau-Wright

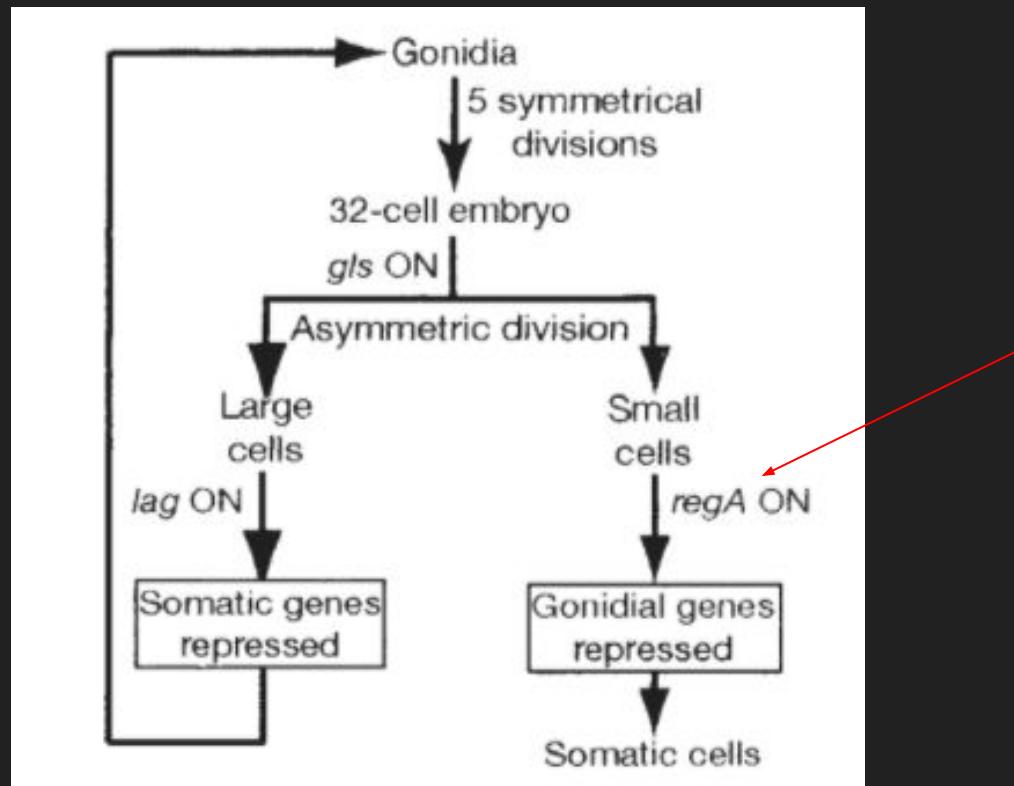
Volvocine Green Algae



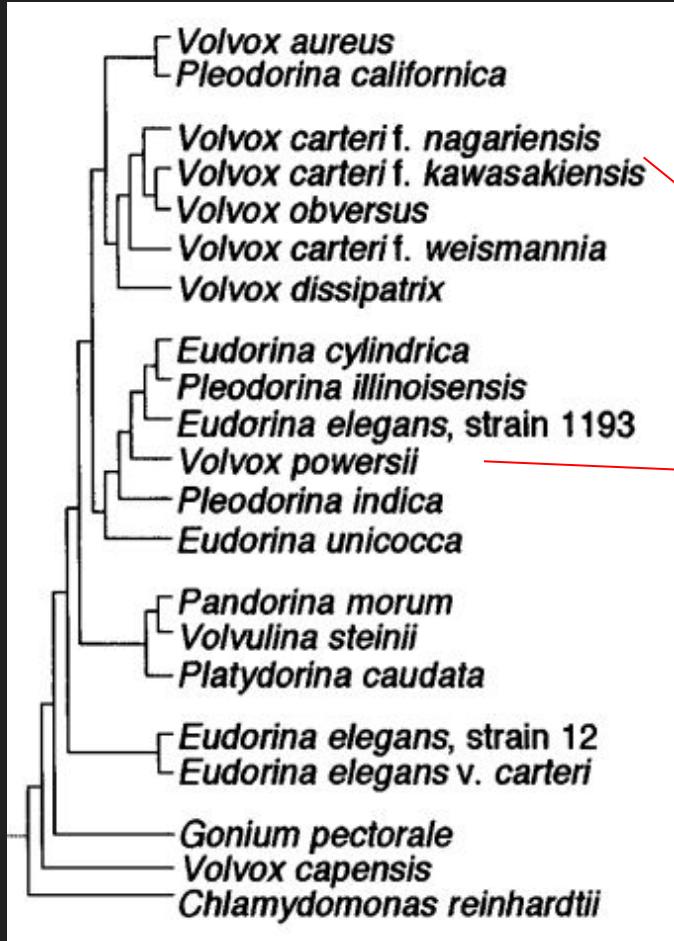
*Volvox
carteri*

Grochau-Wright et al. 2017

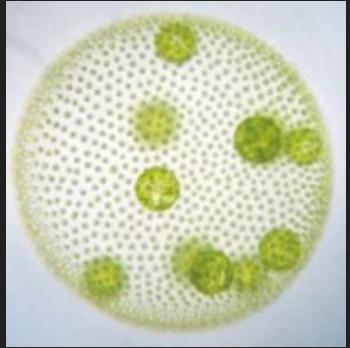
Mechanism of Differentiation in *V. carteri*



Kirk 2005



Asymmetric division

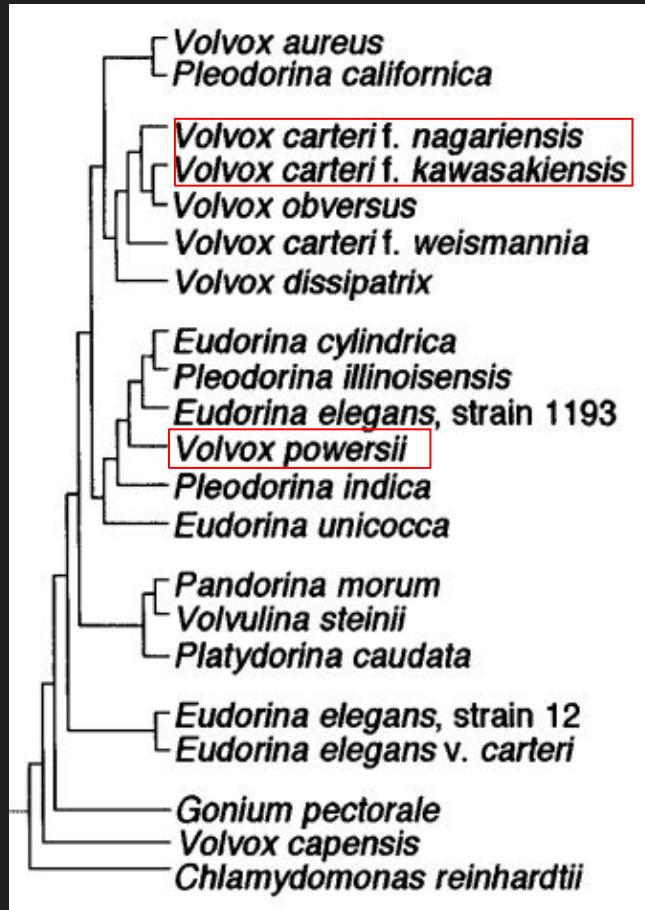


Cellular Differentiation

Unknown Mechanism



Insight

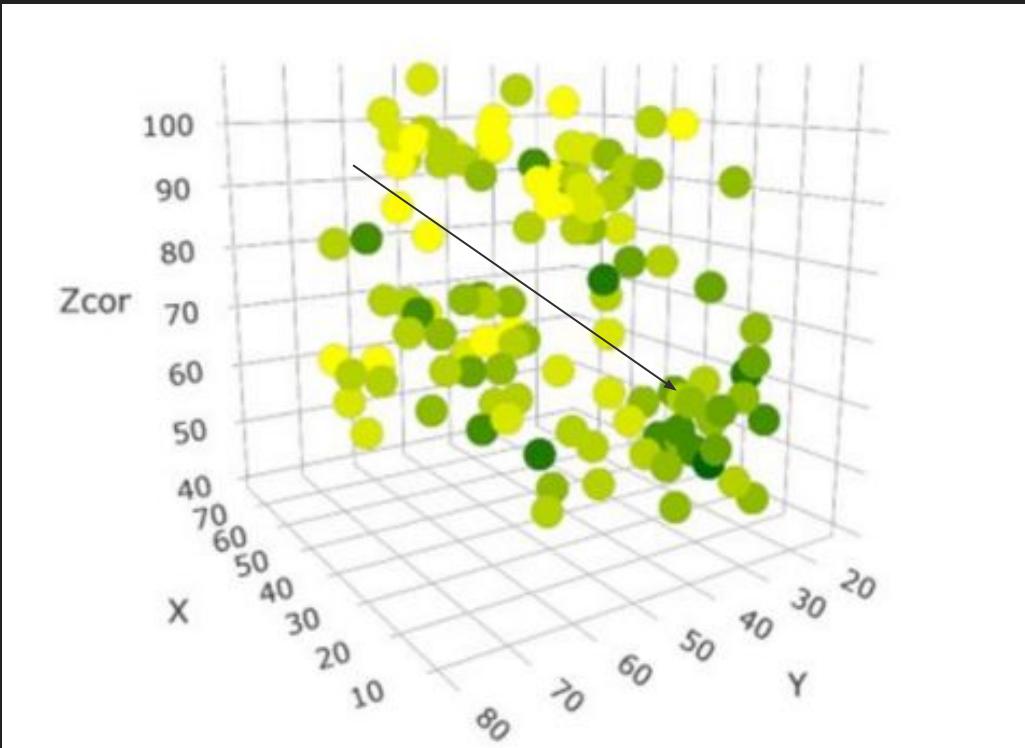


Germ cells are more photosynthetically active than somatic cells

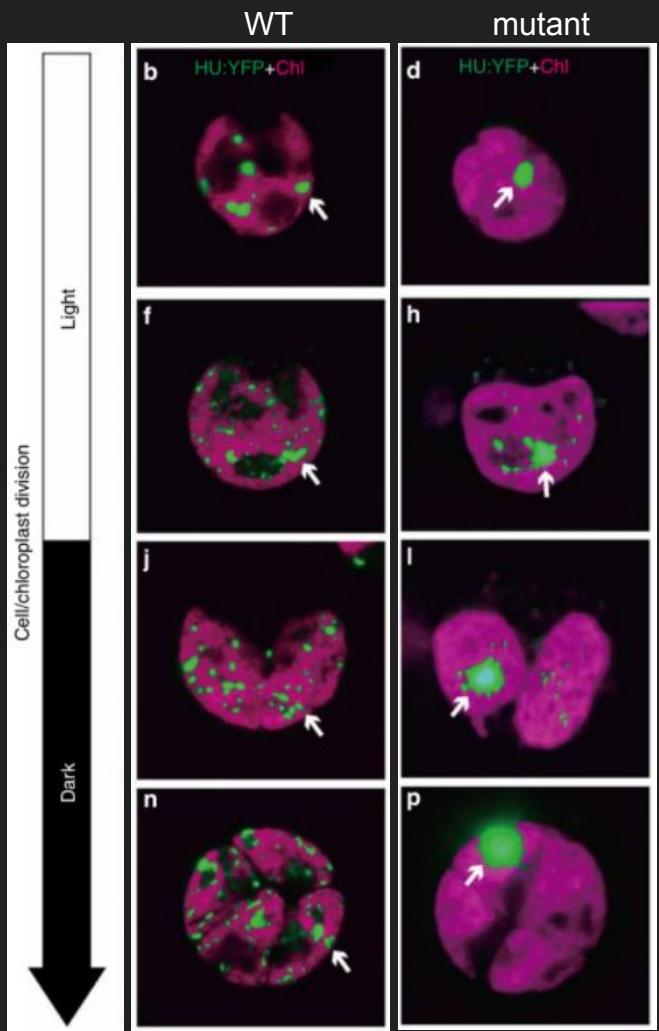
cpDNA count is significantly higher in germ cells

Fate determination is dictated by unknown cytoplasmic factor in two other Volvocine species

cpDNA as Determining Factor

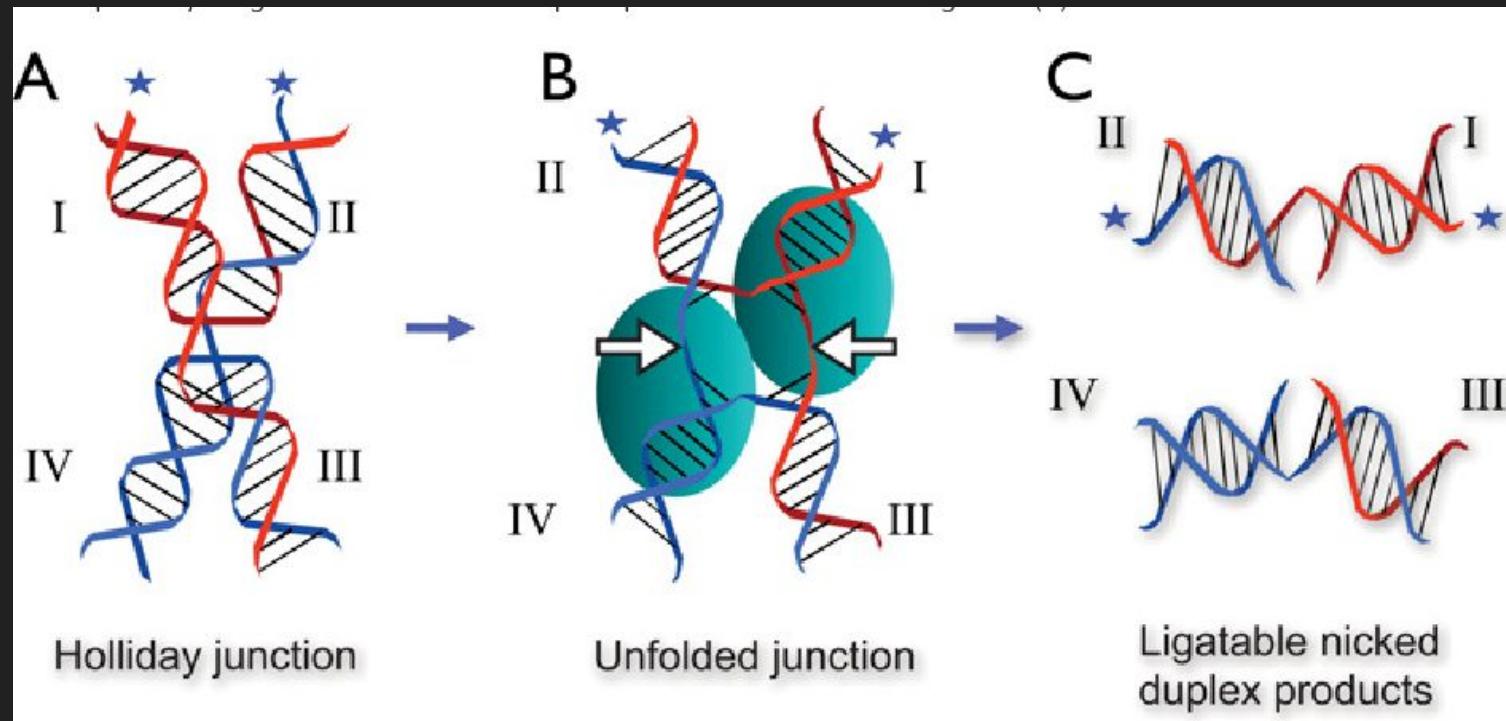


Adapted from Grochau-Wright 2019, pp.123

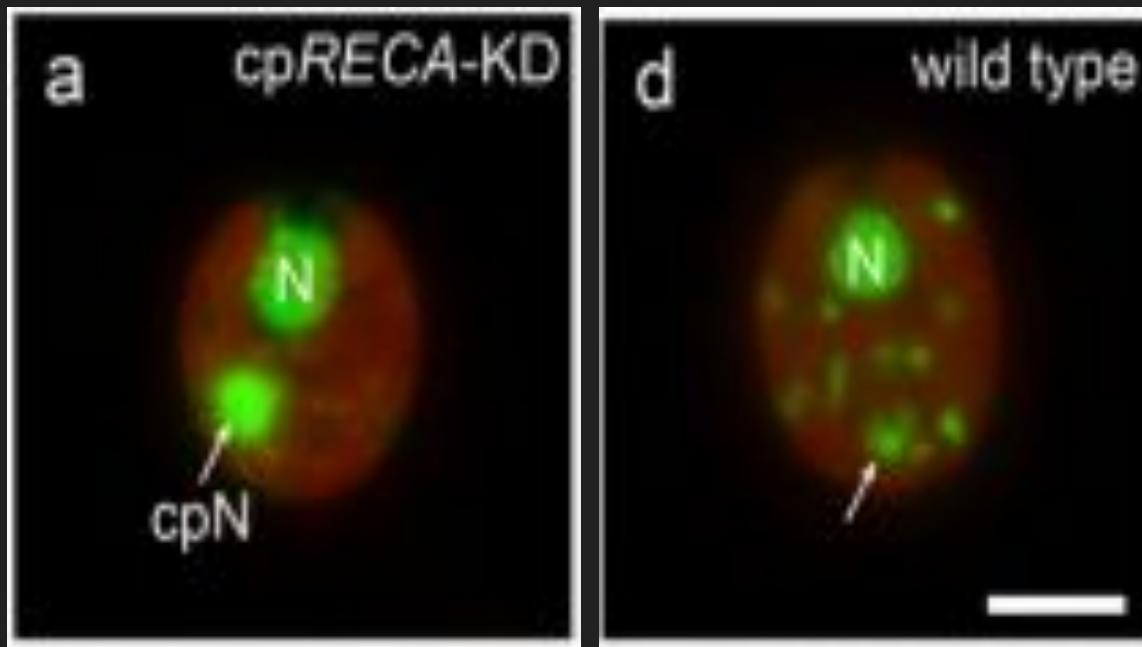


Adapted from
Kamimura et al. 2018

Holliday Junction Resolvase

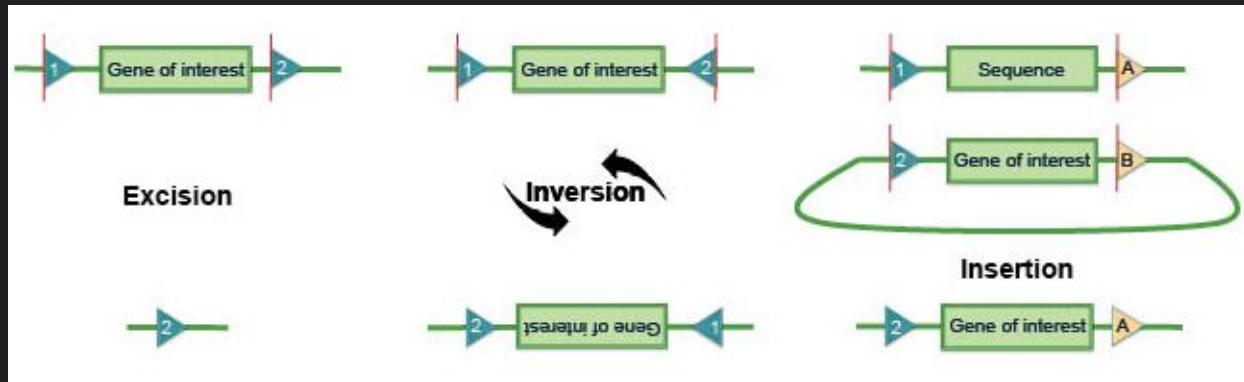
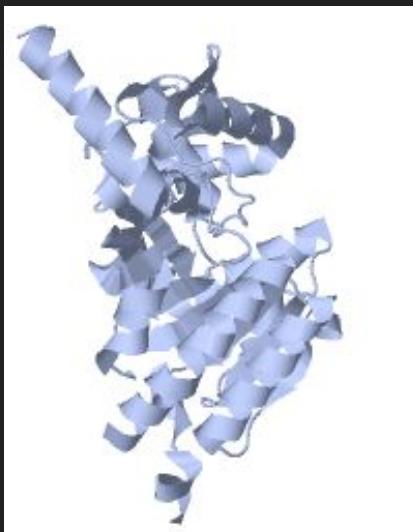


West, 2009



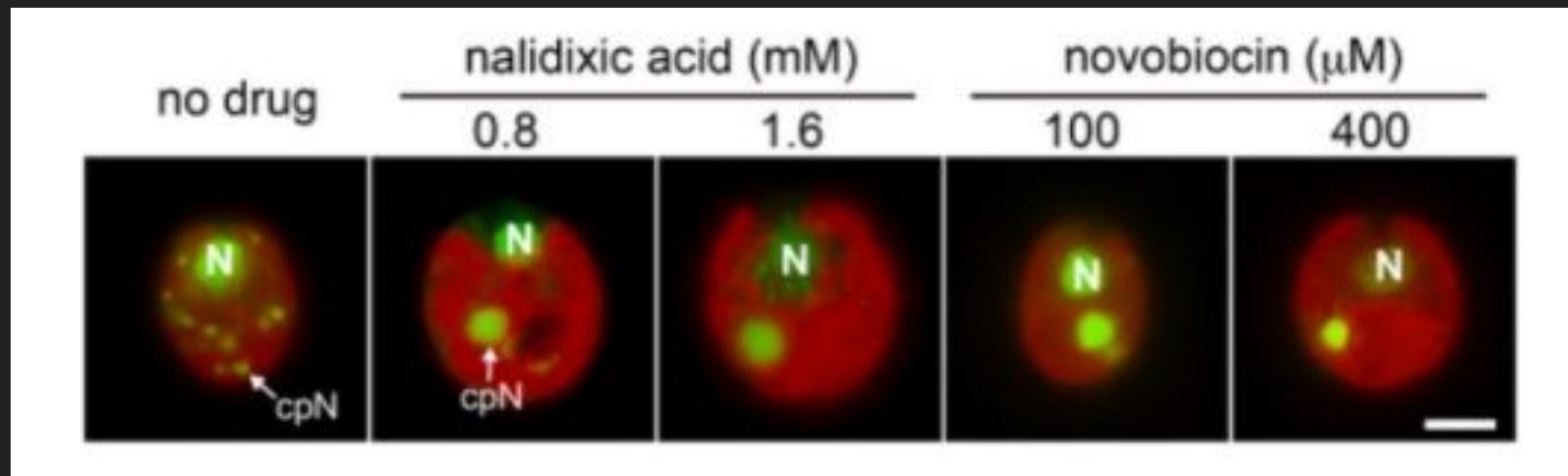
Adapted from Odahara et al. 2016

RecA



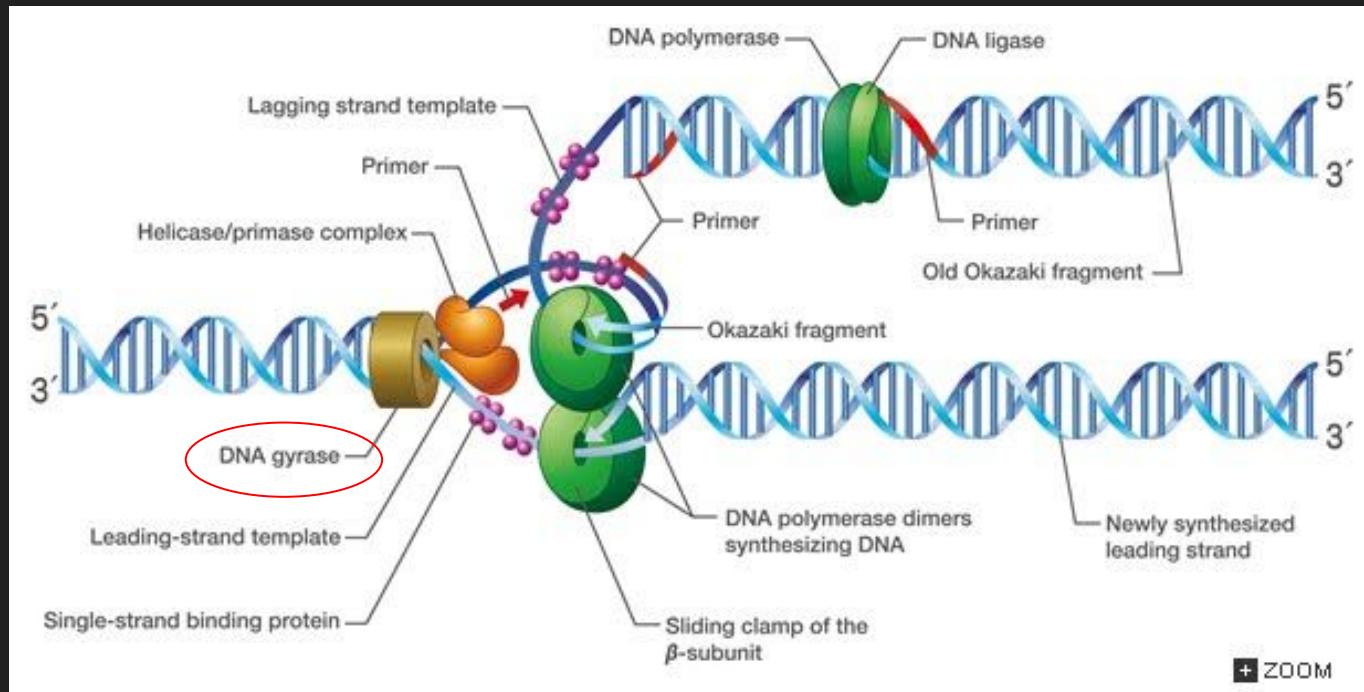
<https://www.genoway.com/technologies/ssr/overview.htm>

https://proteopedia.org/wiki/index.php/Recombinase_A



Odahara et al. 2016

DNA gyrase



<https://sites.google.com/site/dnareplicationsimulator/dna?overridemobile=true>

DNA gyrase

RecA

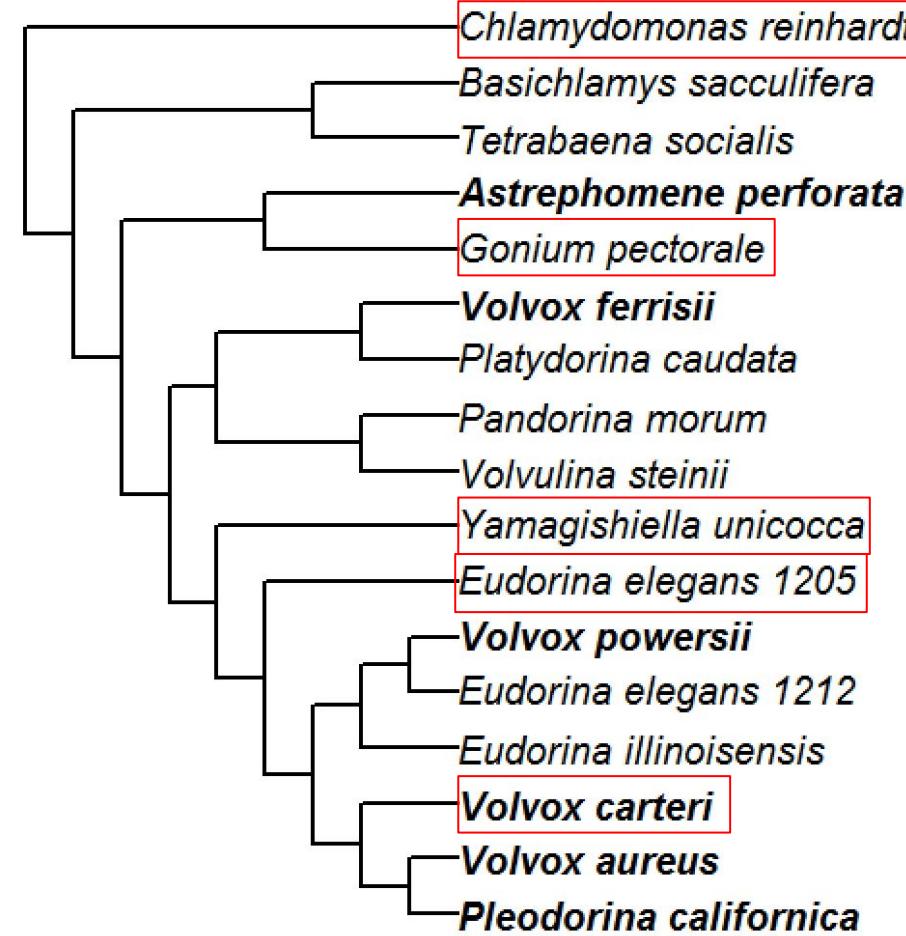
Protein Sequence

Evolutionary
Changes

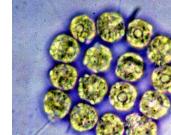
Insight

V. powersii

Holliday
Junction
Resolvase



https://web.mst.edu/~djwesten/MoW/BIO221_2009/C_reinhardtii.html



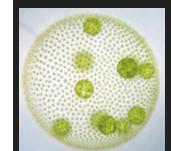
<https://en.wikipedia.org/wiki/Gonium>



http://protist.i.hosei.ac.jp/PDB/Images/Chlorophyta/Yamagishiella/sp_4a.html



<https://en.wikipedia.org/wiki/Eudorina>



https://en.wikipedia.org/wiki/Volvox_carteri

C. reinhardtii | *Gonium pectorale* *Eudorina* sp. *Yamagishiella unicocca* | *V. carteri*

Multicellularity

Find and Extract
Homologs

NCBI, Phytozome

Cellular Differentiation

BLASTP, tblastn

Geneious

Used AUGUSTUS for *E. sp.*, *Y. unicocca*

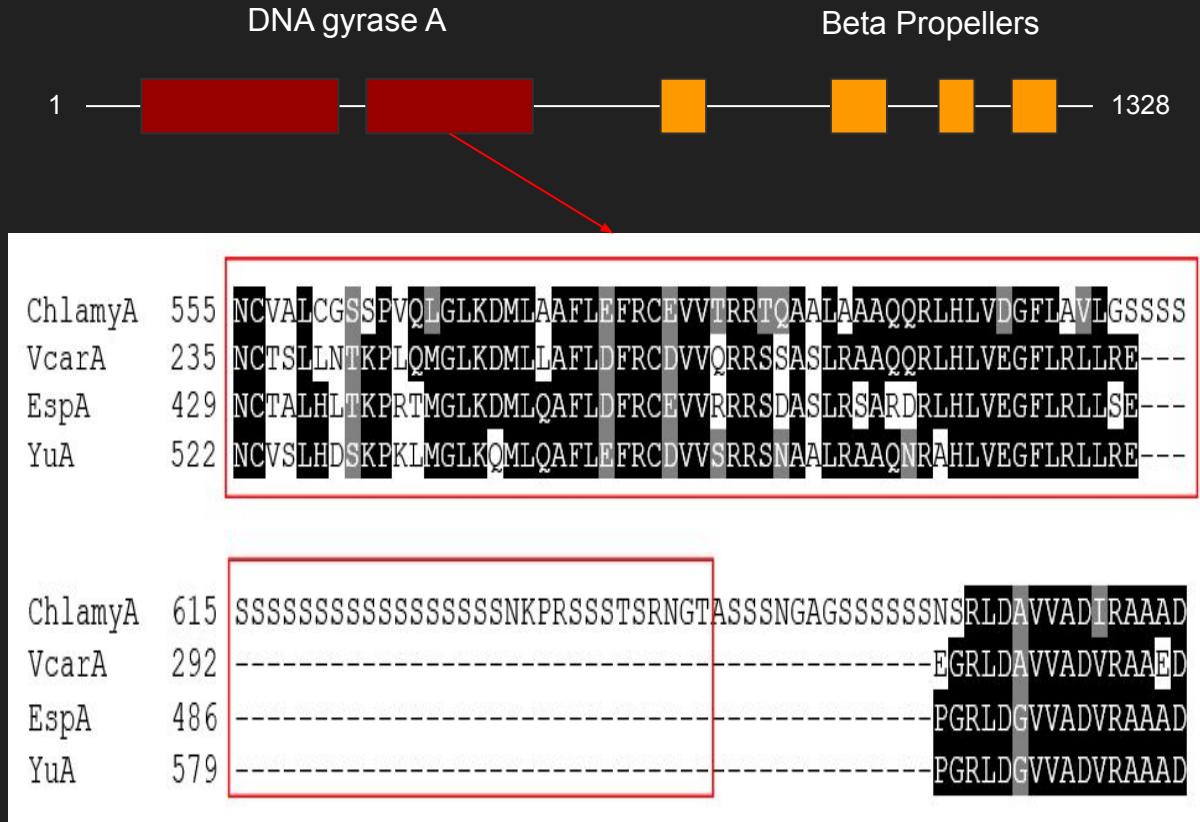


Aligned Sequences with CLUSTAL Omega



Used HMMScan for protein domains

DNA gyrase A



DNA gyrase B



YuB	144	LTVLHAGGKFGGENSGYKVSSGLHGVGISVVNALSEEVVTWWRAGVRYSQRYSRGAPQE
VcarB	177	LTVLHAGGKFGGEDSGYKVSSGLHGVGISVVNALSEEVTVWWRAGVRYSQRYSRGVALE
EspB	172	LTVLHAGGKFGGENSGYKVSSGLHGVGISVVNALSEEAVTVWWRSGVRYSQRYSRGAPE
ChlamyB	120	LTVLHAGGKFGGDNSGYKVSSGLHGVGISVVNALSELTVTWWRAGSRYSQRYSRGAPLE
GonB	138	LTVLHAGGKFGGENSGYKVSSGLHGVGISVVNALSQELTVTWWRAGARYSQRYSRGAPE

YuB	204	EVOLVQLEPGSEEAGRGTGTQVRFLYDRSIFASDASDPLIATRLHELAFLNSAAAIRFR
VcarB	237	EVQRTBLQPDSEEAAGRGTGTQVRFLYDRTIFASDVSYNPDIATRLHELAFLNSSATMRN
EspB	232	EVQRQBLPPDSEEAAGRGTGTQVRFLYDRTIFASDVSYNPDIATRLHELAFLNSAATIRLR
ChlamyB	180	ELRVQILPPGSEEAGRSGTQVRFLYDASIFAKDVAYSADVIATRLHELAFLNARATIRFR
GonB	198	GLRVEALEPDSEEAQRSGTRVRFLYDKDIFAKDVSYSPDVIATRLHELAFLNSCATIRLR

YuB	599	ERV-TGANEEAMYKNNEISSLIVALGLGAEERGPQMGARSGG-----YAS---ESERDN
VcarB	631	ERV-AGVNEAAMYKNAEISSLIVALGLGTDRAPALATRGPD-----VA---VRDTAS
EspB	622	ERLSQGANEEAATYKNAEISSLIVALGLGTDRAPLTATPPA-----PDPLESGREVEAD
ChlamyB	581	ERLTDAEELIMYKNTIESNLIVALGLGTDRSAGIPAAAGSAAAAGGAAAATAEQSAEEAA
GonB	603	ERV-TAANEEQIYKNAEISNLIVALGLGADKAGLRQ-----PAAASPEEQAEADR

YuB	648	KPLEGLRYGKVVILTDADVDGAHIRALLTFLFRYRPQLFYAGNVYVAVPPLYKVERGKS
VcarB	679	KALECLRYGKIVILTDADVDGAHIRALLTFLFRYRPQLFYAGHVYVAVPPLYKVERGRS
EspB	676	KALEGLRYGKVVILTDADVDGAHIRALLTFLFRYRPQLFYRGHVVAVPPLYKVERGKS
ChlamyB	640	KALTQRLRYGKIVVLTDADVDGAHIRLTLTFLFRYRPQLFAAGRHVYVAVPPLYKVERGKS
GonB	652	KALQGLRYGKVVILTDADVDGAHIRSLLLTFLFRYRPQLFTAGHVYVAVPPLYKIERGRS

RecA



ChlamyRec	360	VLAALREDAERTAAIEAAVRDVLRANPDAALVDTEEGDDDDGLGTASTVALDMDDV
EspRec	358	MLQVLREDPERAAAIEAVAVRELLSTNPDAALVDVEGADEDG---PDTTVGLDMDDM
VcarRec	358	MLQLLREDPDRCAAIENAVREILKANPDAALVDVEAGDDDG---PDQTVGLLDLDDL
YuRec	331	MLQALREDPERSAAIELAVREVLIKSNPDAALVDSETGDEGS---PDHTVGLLDV



Holliday Junction Resolvase



1 —————— 882

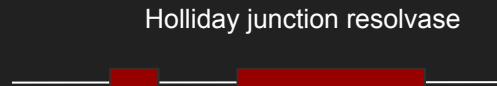


VcarMOC	425	AVLASALASALPPPEERRVALYGYVEVPPILPGDGIISAYTSLWSTGAWLGLLTGMGFA
ChlamyMOC	526	AVLSAALAAAALPPPGEARPVALYGYVEVPPILPGDGNIAYTSLGSWLGLLTGMGFT
EspMOC	321	AVLASALAAAALPPPGDRRRVALYGYVEVPPILPGDGNIAYTSLWSTGAWLGLLTGLGFT
YuMOC	284	AVLARALASALPPPGEIIRRVALYGYVEVPPILPGDGNIAYTSWSTGAWLGLLTGMGFT



Future Research

- Insertions within domains
- Amino acid substitutions at key residues
- Controlled mutations, region knockouts
- Insight in *V. powersii* inheritance



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Subhana Ahmed

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