

Cancer across species: Development of novel model organisms in cancer research

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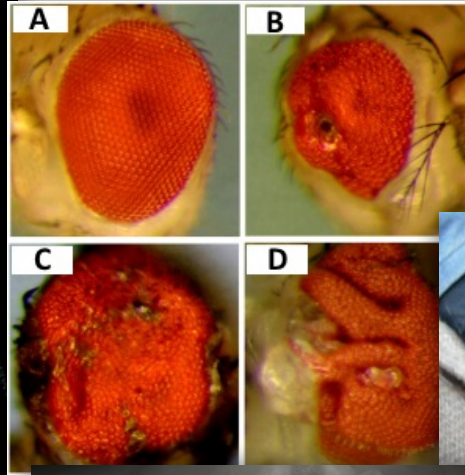
Michelle Culbertson

Arizona/NASA Space Grant Undergraduate Research Symposium

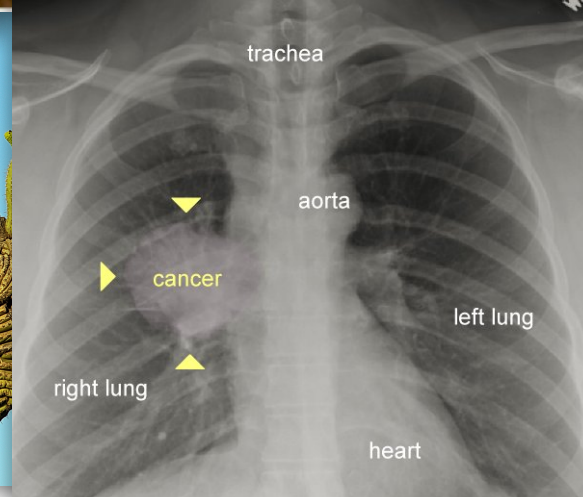
April 22, 2017



Cancer across species



Cancer-like



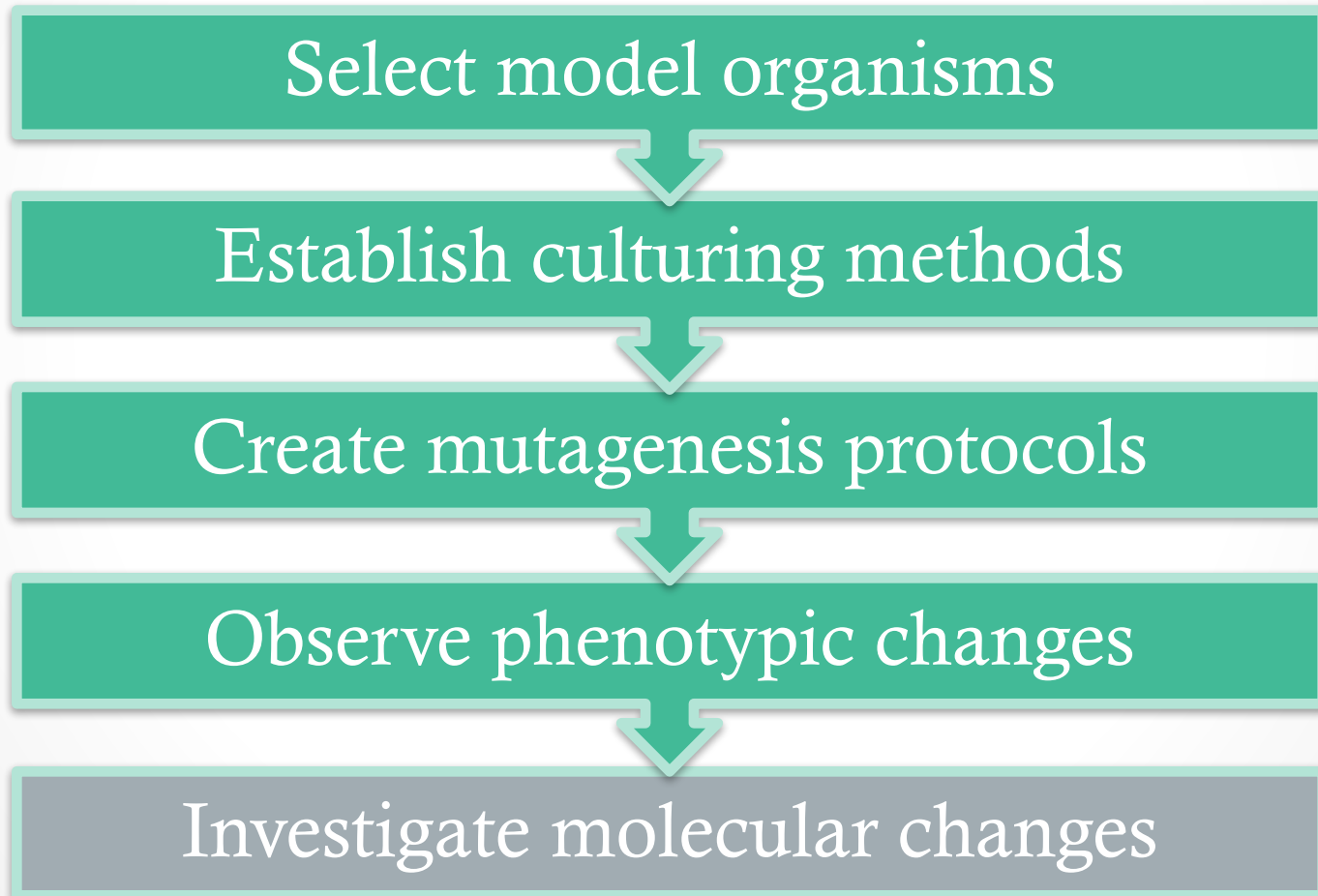
Evolution of cancer

- Cancer develops from accumulated DNA mutations
- Cancer is inherent to multicellular organisms
 - But cancer is not seen in all of them
 - Why?
- What can we learn from new model organisms?

Objective: Study simple model organisms to identify if they get cancer, or how they can prevent it



Methods



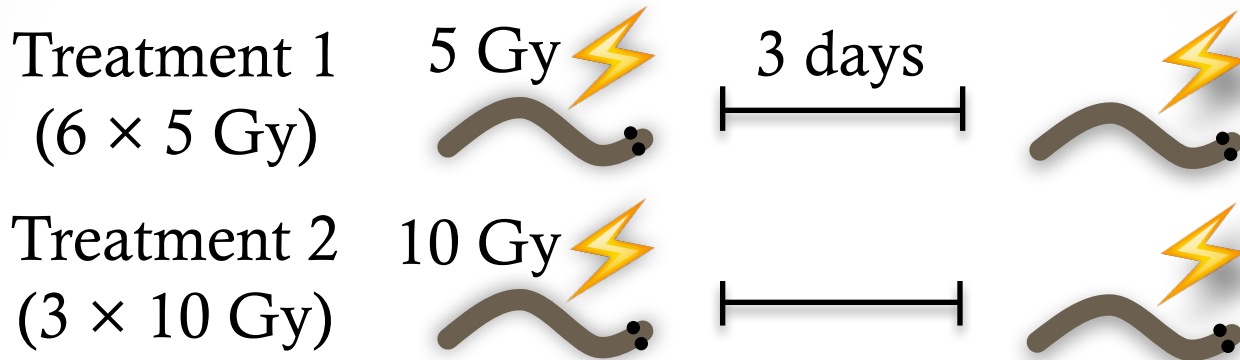
Macrostomum lignano

- Free-living marine flatworm species
 - Lifespan: 6-7 months, up to 2 years
 - Powerful regenerative ability due to stem cells
 - No cancer-like phenomena observed
- Conserved genes and pathways with humans
- Cultured in Petri dishes with *Nitzschia curvilineata* algae

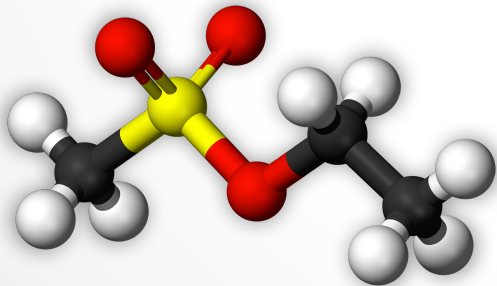


Methods

Physical mutagenesis



Chemical mutagenesis



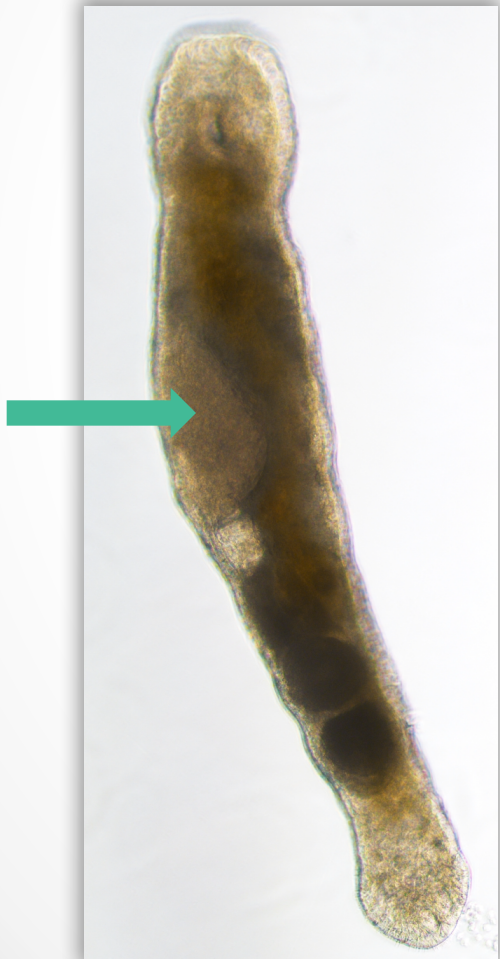
50 mM ethyl methanesulfonate
(EMS)

Current results

- Dosage optimized to 30 Gy
 - Minimal mortality
 - Minimal effects on reproduction
- Cancer-like phenotype seen in irradiated worms



Current results



- 2 individuals from 6×5 Gy treatment with cancer-like phenotypes
- More phenotypes observed in 6×5 Gy than 3×10 Gy

Current results

- Dosage optimized to 30 Gy
 - Minimal mortality
 - Minimal effects on reproduction
- Cancer-like phenotype seen in irradiated worms
 - Possibly originating in the gonads
 - Masses appear to grow over time
 - Observed ~3 months after first treatment
 - Preliminary data suggests higher mortality in 6×5 Gy
- No new phenotypes seen yet after chemical treatment



Future goals

- Further analysis of tumor-like phenotype
 - Histological analysis of tumor-like phenotype to confirm cancer growth
 - Gene and protein expression, specifically for conserved pathways
- Test other mutagenesis methods
- Continue studying other model organisms
 - *Trichoplax adhaerans*
 - *Tethya wilhelma*



Acknowledgements

- Maley lab members
- ASU/NASA Space Grant



Arizona/NASA
Space Grant



Any questions?
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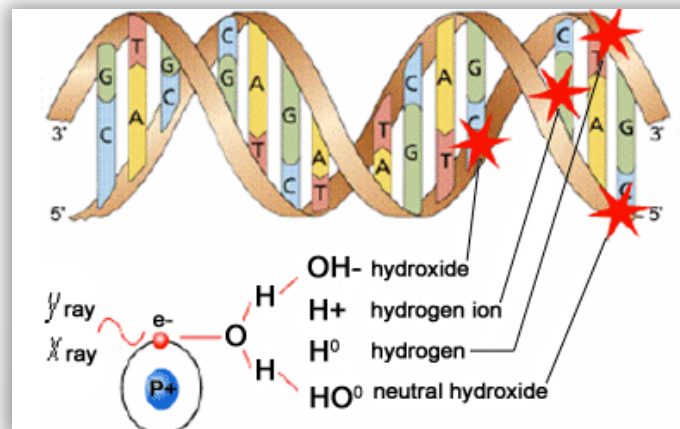
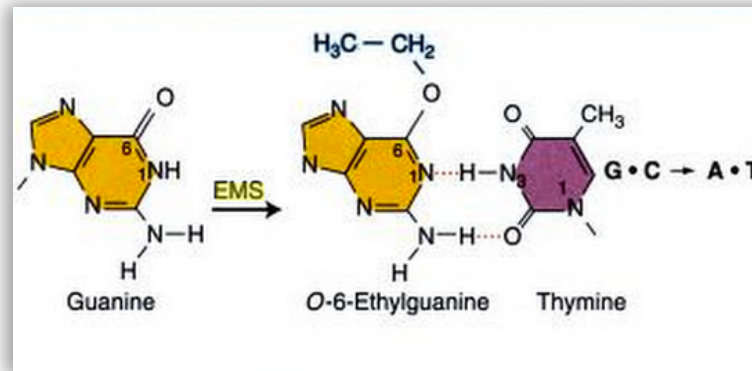


References

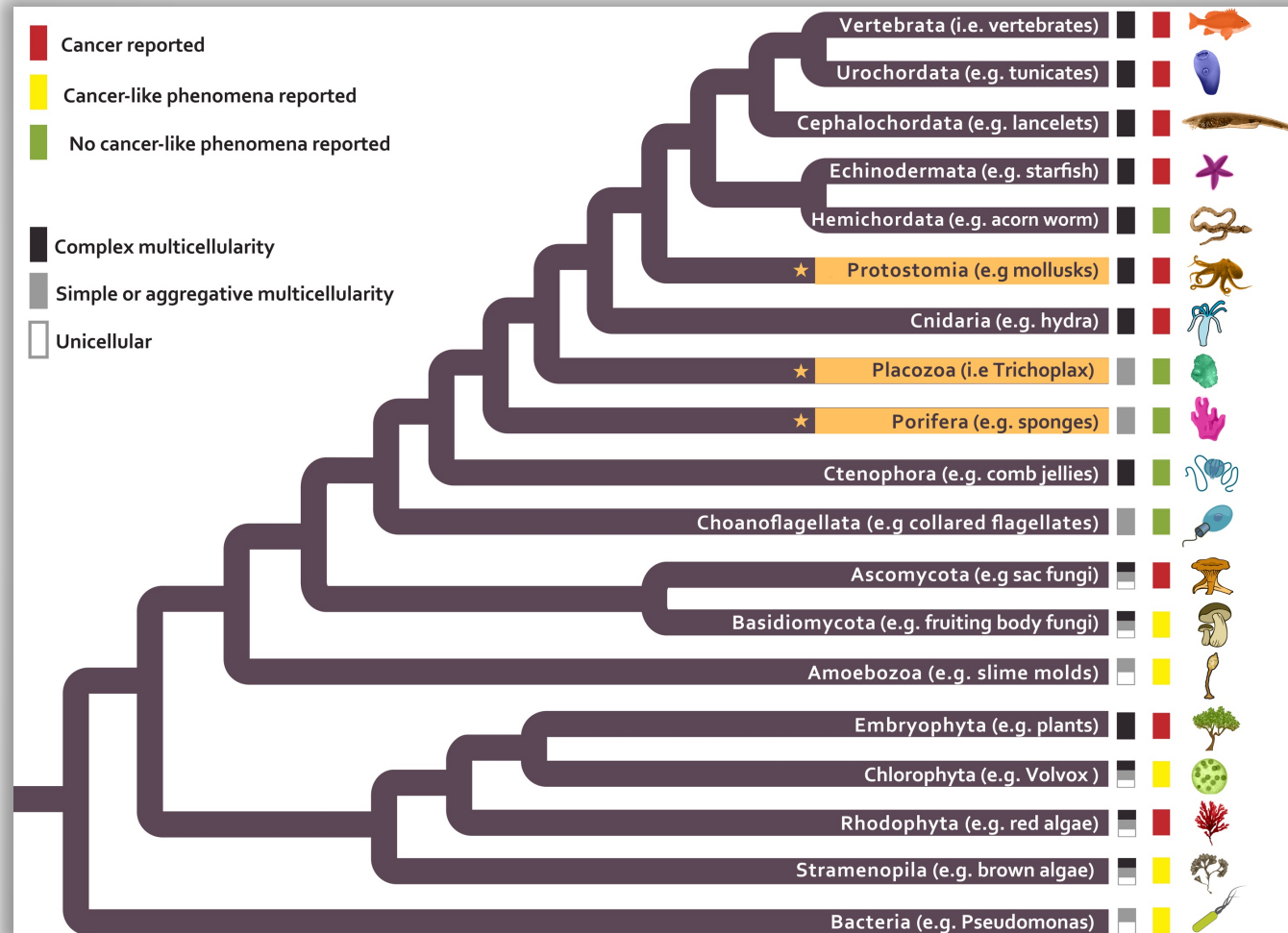
- Photo credits
 - **Tasmanian Devils evolving resistance to facial cancer. 2016.**
<https://www.greenleft.org.au/content/tasmanian-devils-evolving-resistance-facial-cancer>
 - Alan English. 2015. <https://www.flickr.com/photos/alanenglish/4540101760/>
 - Domazet-Lošo T, Klimovich A, Anokhin B, Anton-Erxleben F, Hamm MJ, Lange C, Bosch TC. Naturally occurring tumours in the basal metazoan Hydra. Nature communications. 2014 Jun 24;5.
 - Lung Cancer Images. http://www.aboutcancer.com/lung_xrays_abnormal.htm
 - Uhlirova M, Jasper H, Bohmann D. Non-cell-autonomous induction of tissue overgrowth by JNK/Ras cooperation in a Drosophila tumor model. Proceedings of the National Academy of Sciences of the United States of America. 2005 Sep 13;102(37):13123-8.
 - Griffiths, A.J.F.; Wessler, R.C. and Carroll, S. (2008). Introduction to Genetic Analysis. W H Freeman & Co.
 - Effects of Ionizing Radiation on DNA. Teach Nuclear. <http://teachnuclear.ca/all-things-nuclear/radiation/biological-effects-of-radiation/effects-of-ionizing-radiation-on-dna/>
- Aktipis, C. A., Boddy, A. M., Jansen, G., Hibner, U., Hochberg, M. E., Maley, C. C., & Wilkinson, G. S. (2015). Cancer across the tree of life: cooperation and cheating in multicellularity. Philosophical Transactions of the Royal Society B: Biological Sciences, 370(1673), 20140219–20140219.
- Mouton, S., Willems, M., Braeckman, B. P., Egger, B., Ladurner, P., Schärer, L., & Borgonie, G. (2009). The free-living flatworm *Macrostomum lignano*: A new model organism for ageing research. Experimental Gerontology, 44(4), 243–249.



Mutagenesis methods



Cancer across life



Culturing conditions

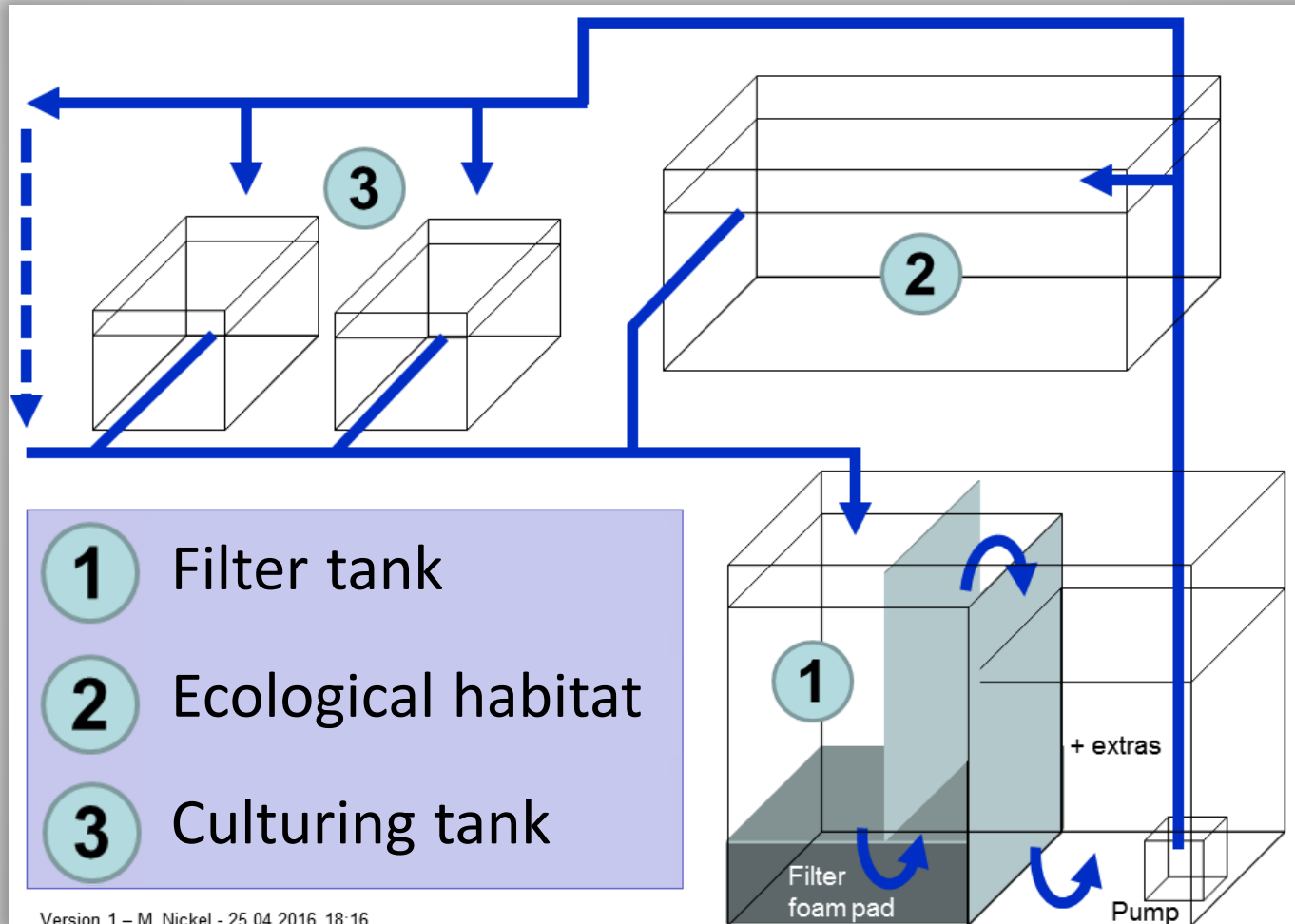
Organism	Media	Temp (°C)	Food	System
<i>M. lignano</i>	f/2	23	<i>Nitzschia curvilineata</i>	Petri dishes
<i>T. adhaerans</i>	ASW	23-25	<i>Pyrenomonas helgolandii</i>	Aquarium and plates
<i>T. wilhelma</i>	ASW	23-25	Artificial plankton (<i>Aquakultur-Genzel</i>)	Aquarium with ecological environment

Artificial seawater (ASW): 32.5% salinity (by weight)

f/2: ASW with vitamins, trace metals, and extra salts



Sponge culturing system



Version 1 – M. Nickel - 25.04.2016 18:16

