

Do cancers represent a reversal to ancient modes of organismal life?
A project to tackle the question using bioengineering, evolution and development

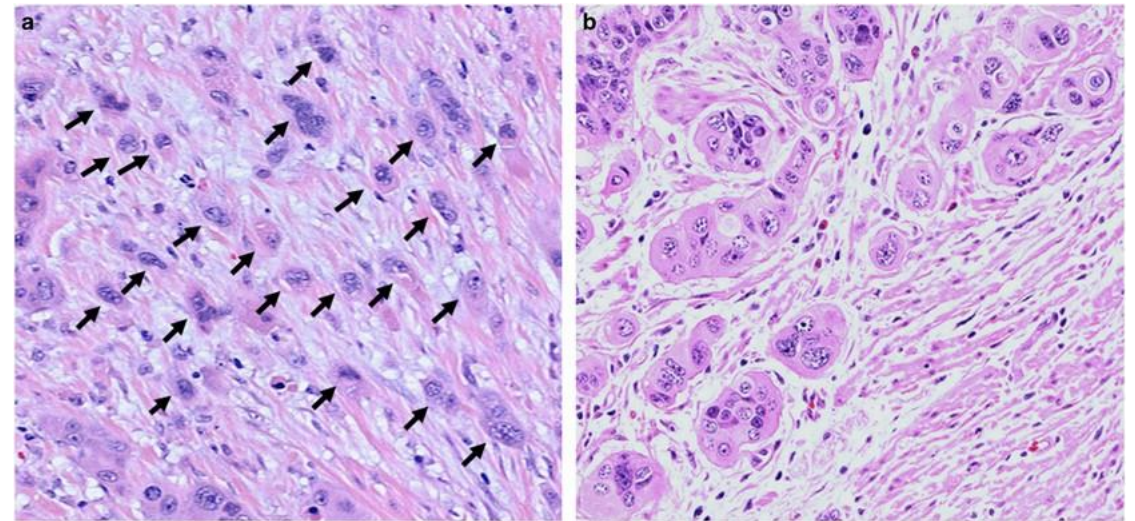
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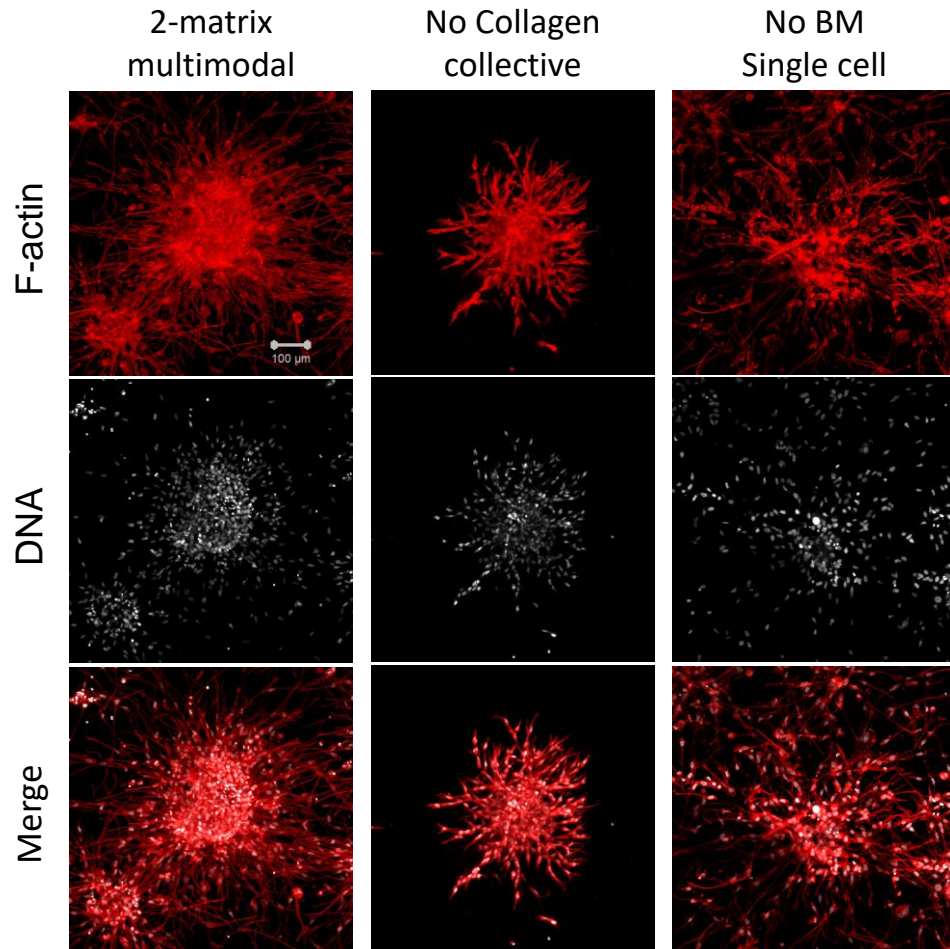
Cancers show stunning diversity in migration modes

		Cell-cell junctions	Tumor type
Individual-cell migration	Single-cell migration		
	Amoeboid	-	Leukemia, lymphoma cell subsets (all tumors)
Multicellular streaming	Mesenchymal	-	Stromal tumors, epithelial tumors after EMT
	Amoeboid (multicellular)	?	All tumors developing amoeboid single-cell dissemination
	Mesenchymal (multicellular)	(+)	Tumors with mesenchymal invasion; fibroblasts leading tumor cells
	Cluster	++	Moderately differentiated epithelial tumors
Collective cell migration	Solid strand	++	Moderately differentiated epithelial tumors with subregions after EMT; basal and squamous cell carcinoma
	Strand (with lumen)	++	Differentiated epithelial tumors; vascular neoplasia
	Strand (protrusive)	++	Moderately differentiated epithelial tumors lacking EMT
	Outward pushing tumor	++	All solid tumors
Expansive growth	++	All solid tumors	

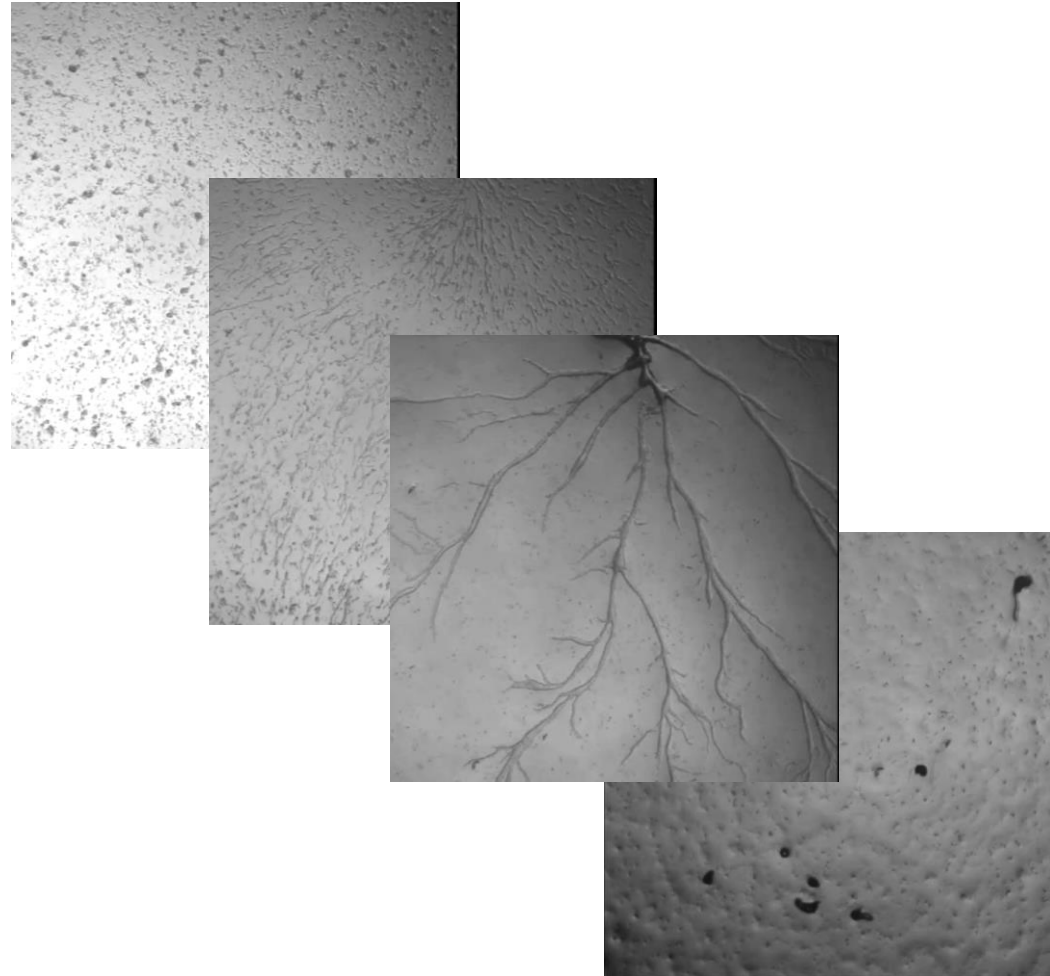


Tumor budding,
Lugli et al, *Mod Pathol*, 2016

Such behaviors are impressive and complex at the collective level



But stunning collective behavior can be seen in evolutionarily distant social organisms such as Dictyosteliid amoeba!!!



How generically similar are collective behaviors seen for cancer cells and social amoeba?

Activities as part of dissertation project...

- Videograph cancer cells migrating under diverse bioengineered scaffold platforms
- Videograph dictyosteliid cells (laboratory and from the wild) migrating under diverse bioengineered scaffold platforms
- Build theoretical models of collective migratory behavior shown by cancer cells and social amoeba
- Investigate the effects of the microenvironment of interconversions between migratory behaviors.
- Perturb key molecular players involved in migration for both systems to observe effects at the collective level

Techniques to be exposed to

1. Cell biology: cell tissue and organoid cultures, confocal and epifluorescence time lapse microscopy
2. Molecular biology: cloning, gene expression perturbation
3. (in collaboration): second harmonic generation microscopy, multiscale modeling, rheology, microfluidics

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Collaborators on this project: (opportunities for potential co-mentoring/collaboration)

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- Vidyanand Nanjundiah**, Centre for Human Genetics, Bengaluru (pattern formation in dictyostelids)
- Mariana Benitez**, Universidad Nacional Autónoma de México (pattern formation and collective behavior in myxobacteria)
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