

Evolution of microRNAs in Amoebozoa and implications for the origin of multicellularity

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Affiliations + expand

PMID: 38375870 PMCID: PMC11014262 DOI: 10.1093/nar/gkx109

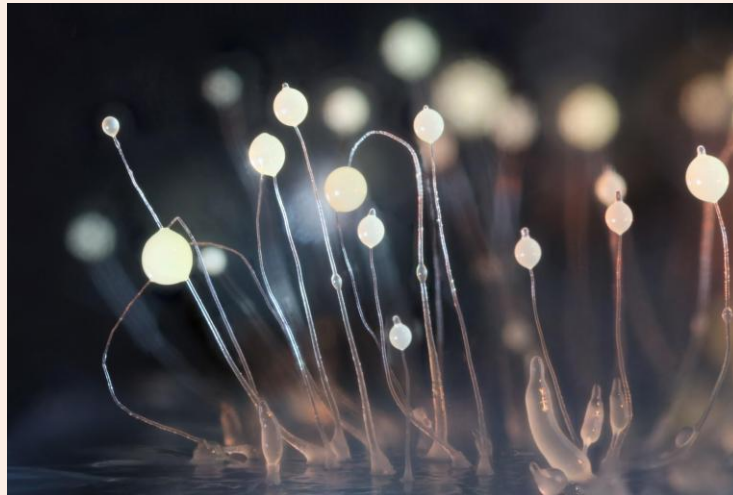
<https://pubmed.ncbi.nlm.nih.gov/38375870/>

Gillian Myers

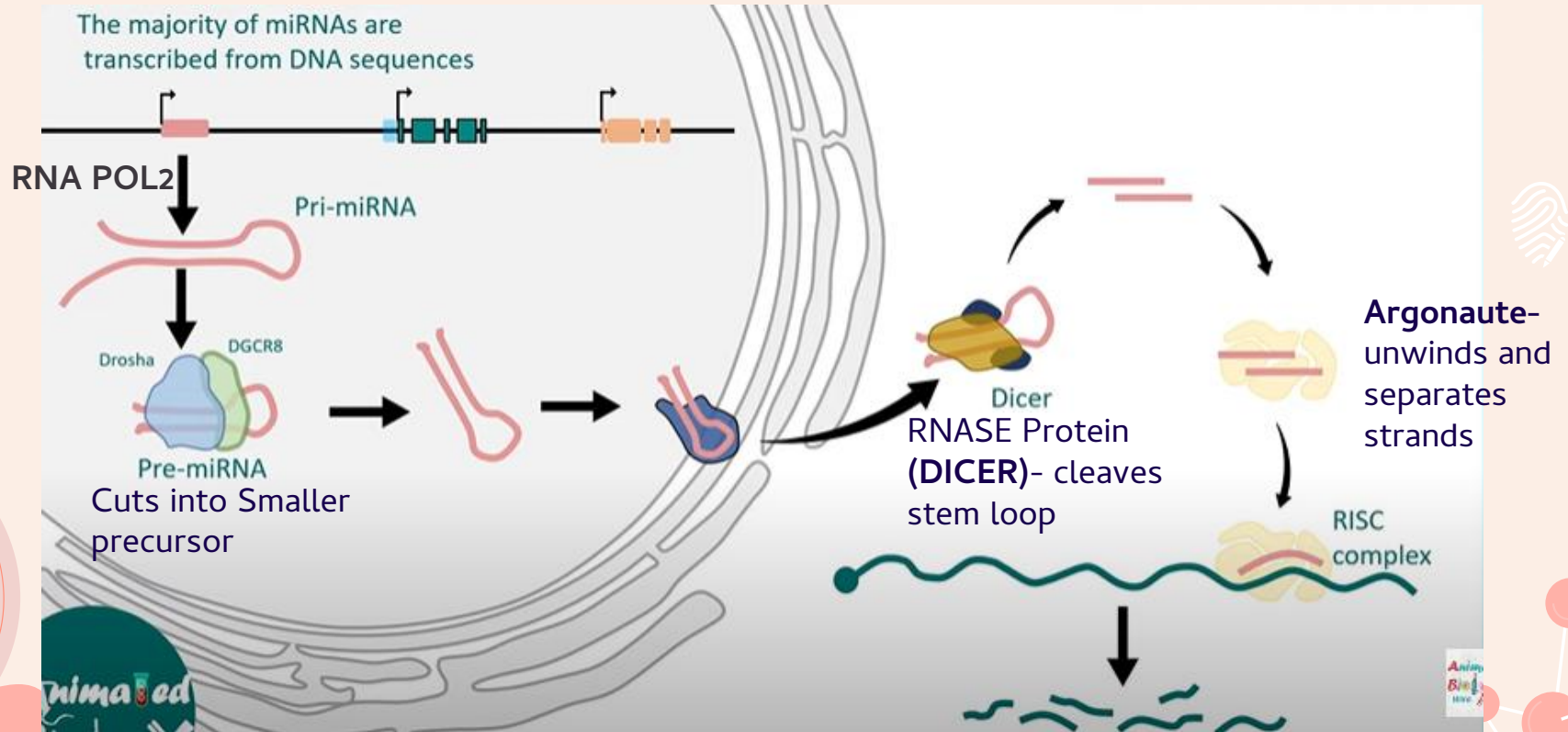


Introduction

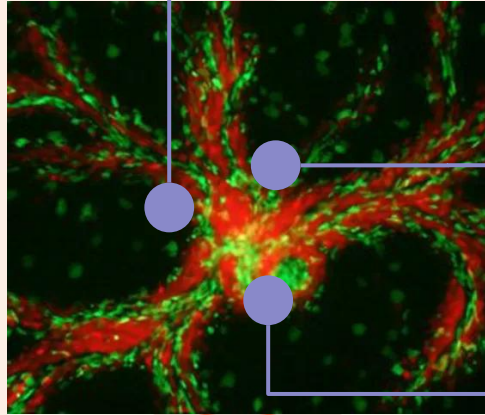
- miRNA discovered in plants and animals
- miRNA commonality should be explored outside of these lineages...so let's look at amoebozoa!
- Amoebozoa has unicellular and multicellular life cycles
- Previously, miRNA identified in *D. discoideum* (amoeba), now expanded to 8 other amoebozoa species
- **Main Question:** Are miRNA's required in the transition from unicellularity to multicellularity?



Introduction



KNOWLEDGE GAPS



1

Convergent Evolution

miRNA machinery are similar between animals and plants however...

2

Uni to Multi

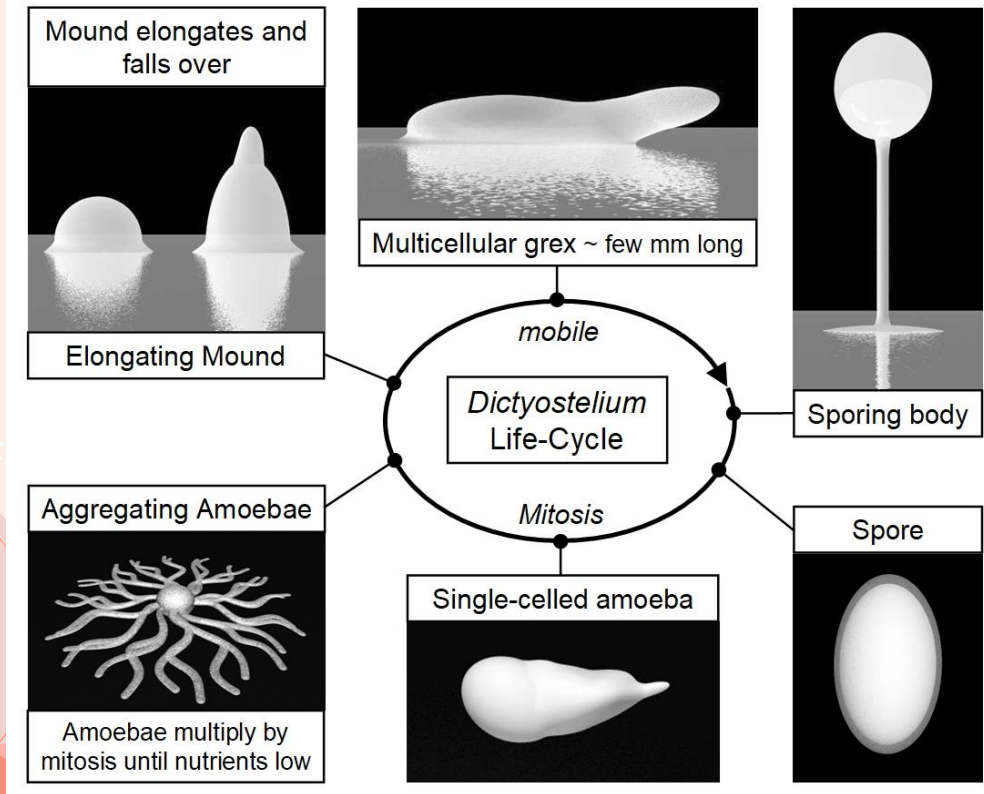
miRNA regulation found in unicellular plants and animals

3

miRNA in other Social Amoeba

Organisms w/ clonal multicellularity (plants & animals) have cell differentiation, what about organisms w/ aggregative?

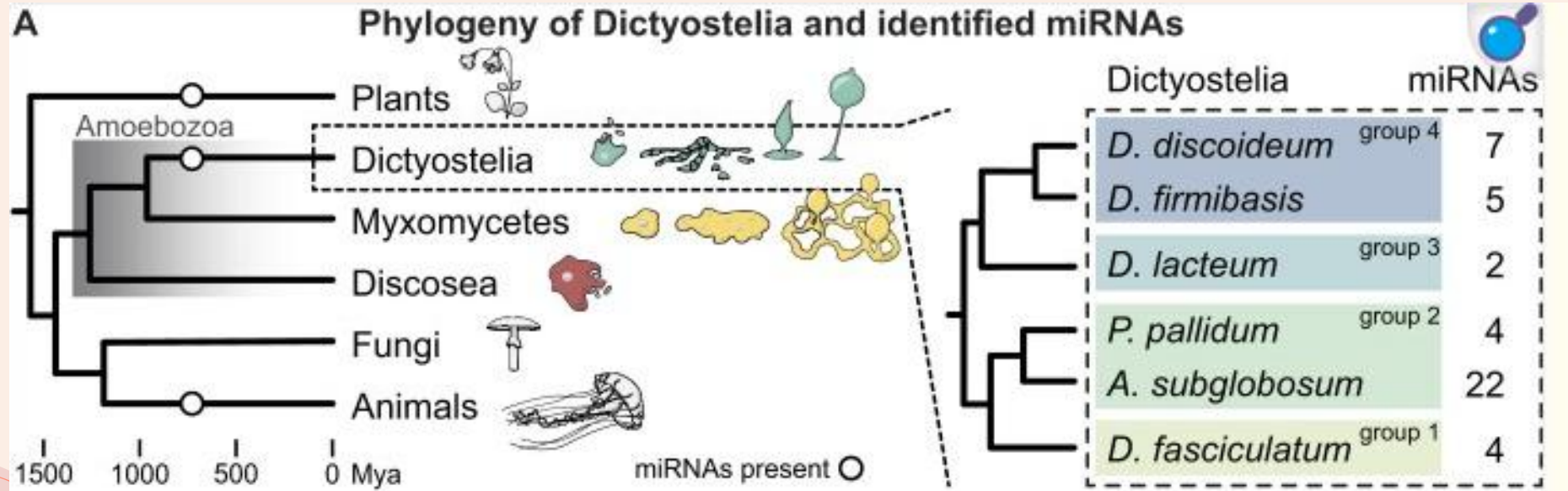
Why Amoebas?



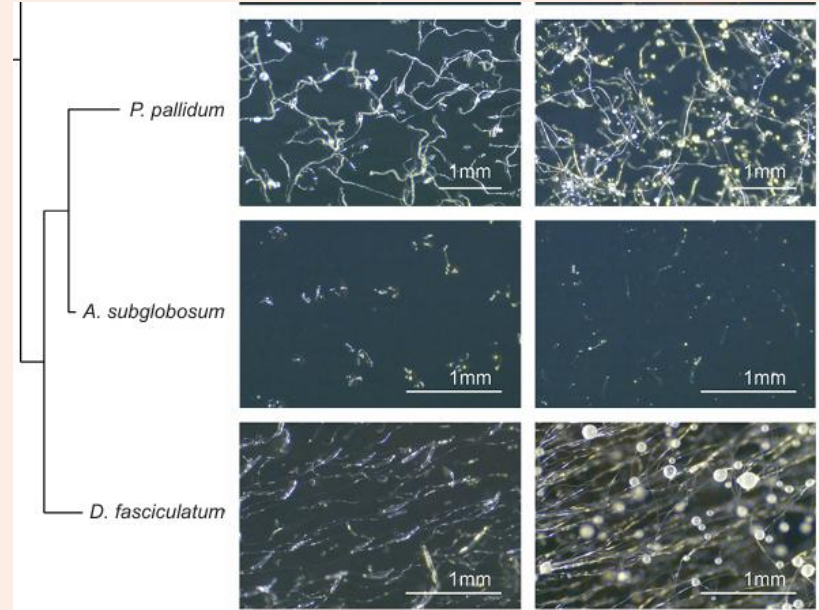
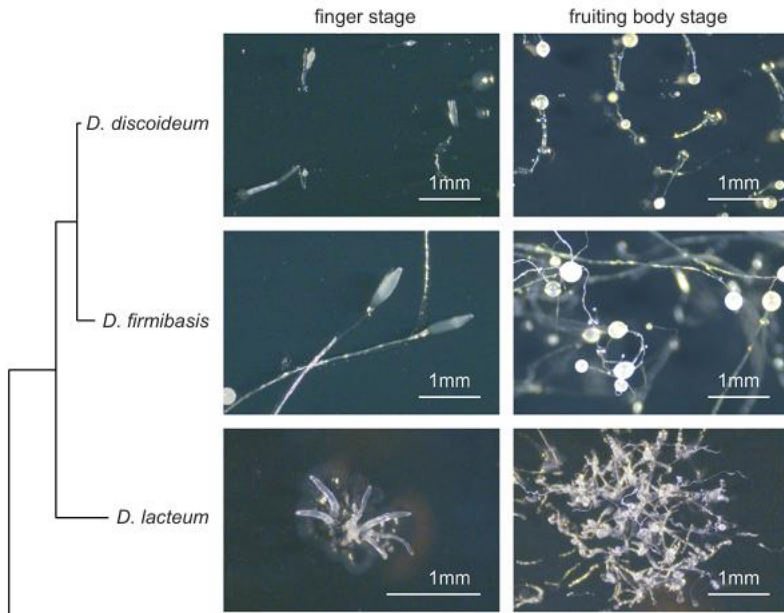
3 Criteria:

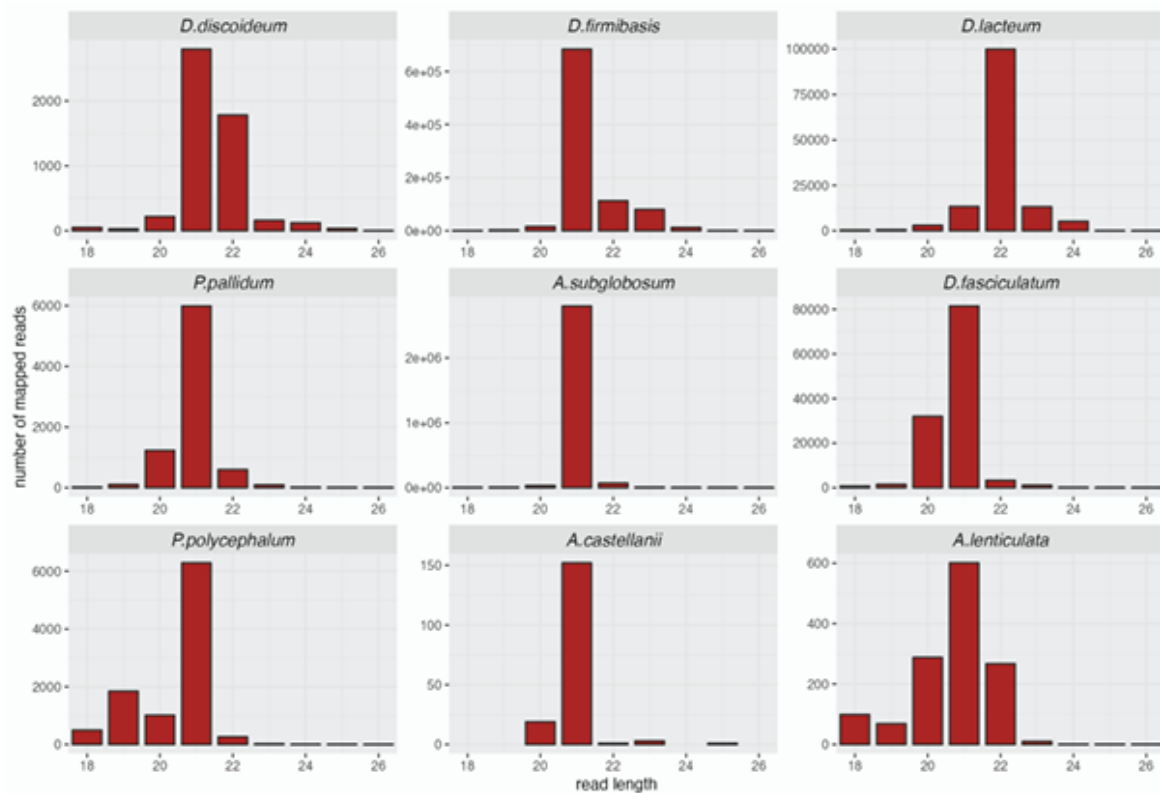
1. Defined secondary structure of the hairpin with mapped mir-5p and 3p
1. Evidence that miRNA is precisely cleaved from the miRNA hairpin and no other small RNA's are generated
1. miRNA candidates are not derived from other structured ncRNA's

miRNA Prevalence



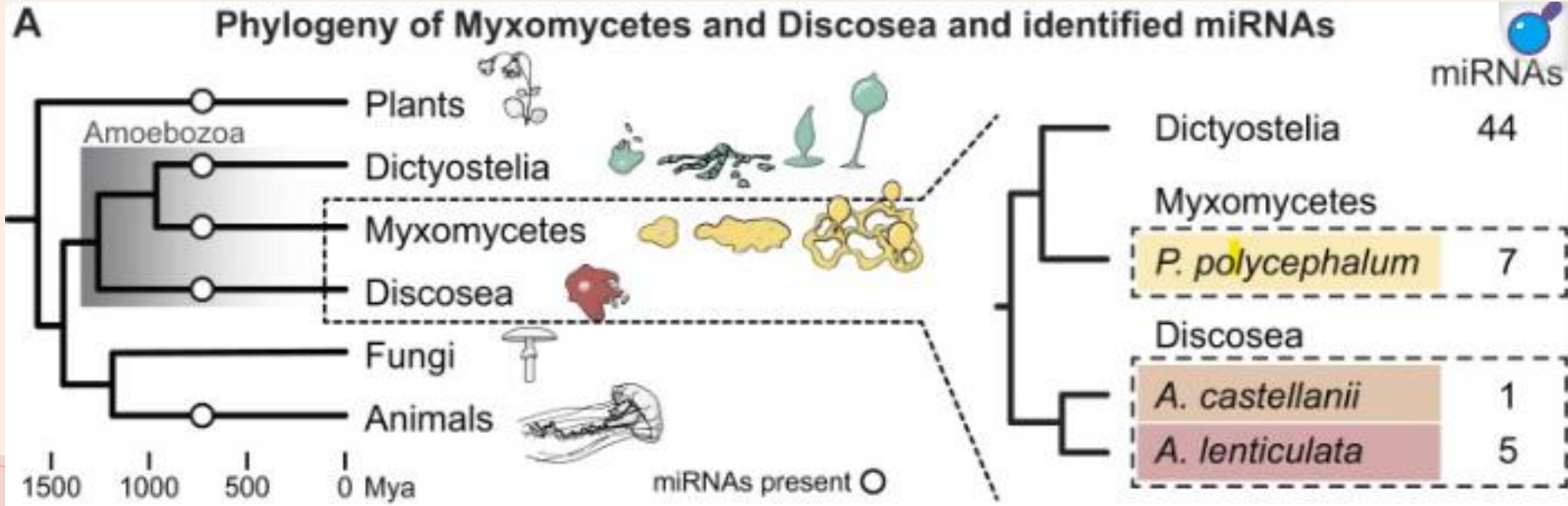
miRNA present in 6/6 Dictyostelid





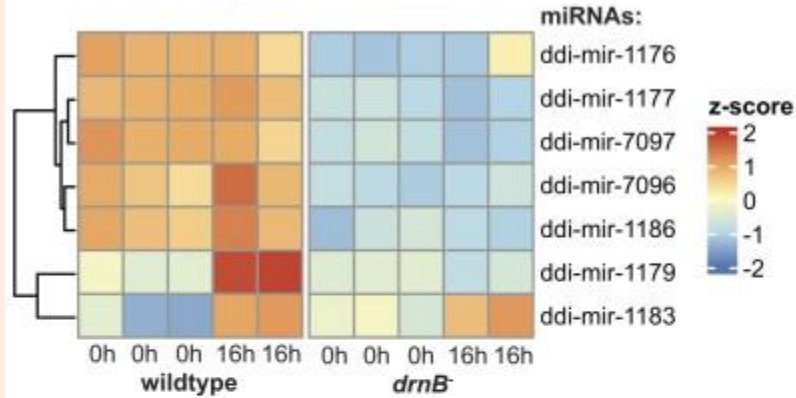
Supplementary Fig. 4 | Length distribution of sRNAs mapping to miRNA-loci. Histogram of read lengths mapping to loci of miRNA-hairpins. For *D. firmibasis*, mapping was done to the de-novo sequenced genome.

miRNA in Uni- to Multi-

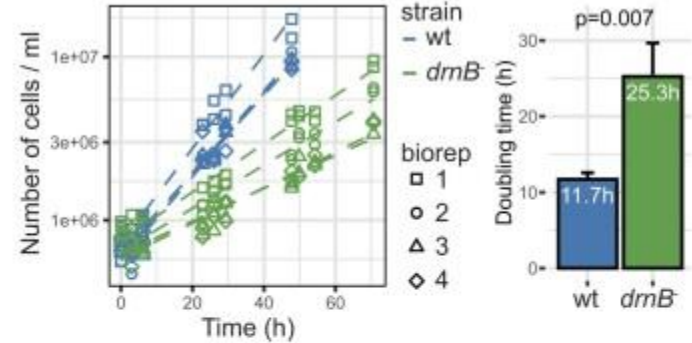


miRNA not required in transition + in *D. discoideum*

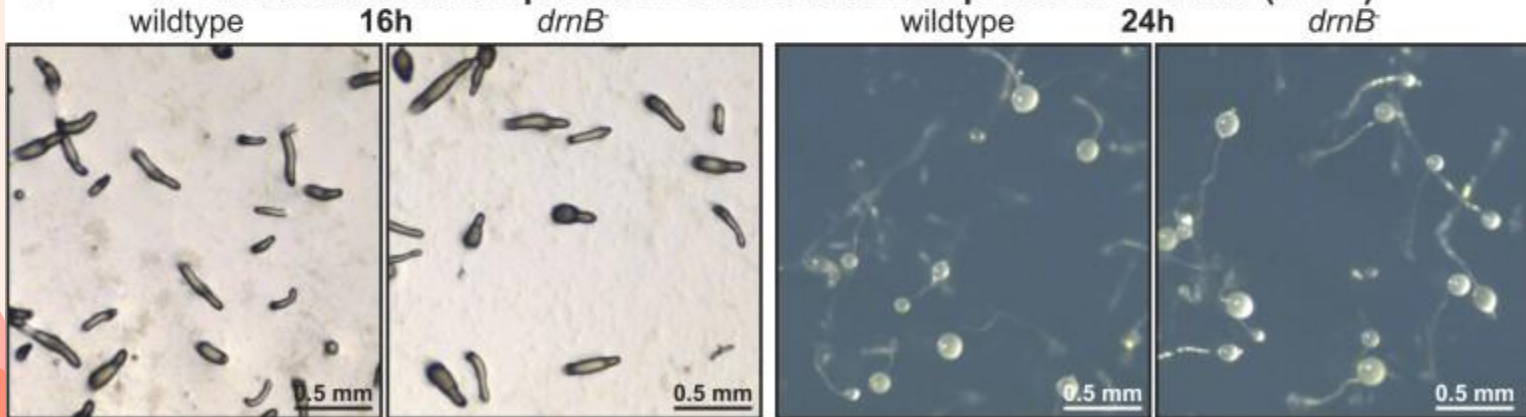
A miRNA expression in wt and *drnB*⁻ cells



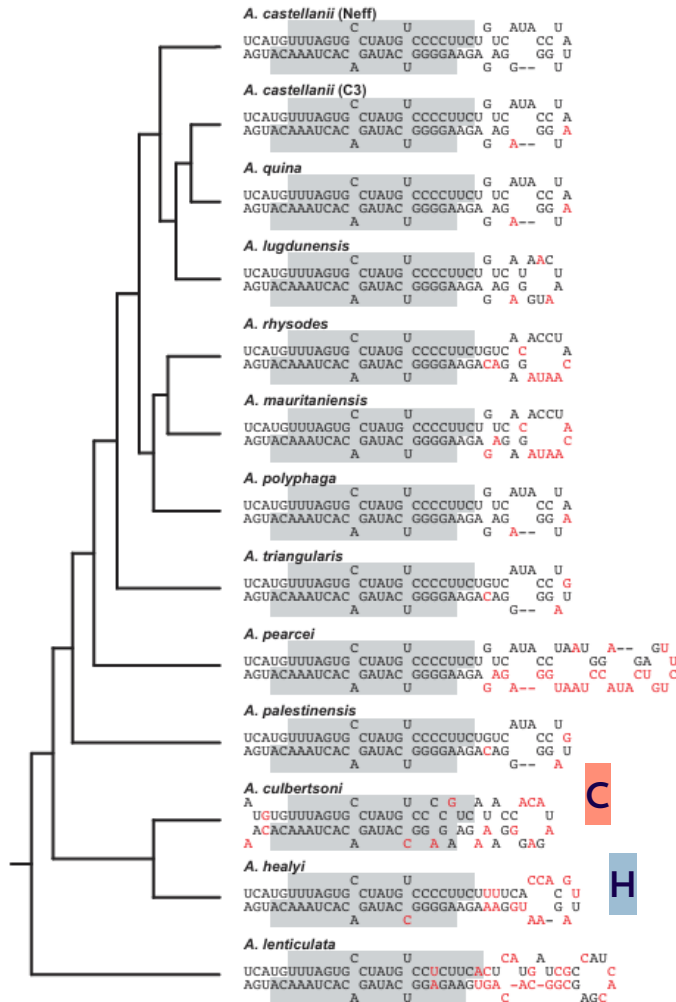
C *drnB*⁻ growth and doubling time



B Multicellular development in *D. discoideum* depleted of miRNAs (*drnB*⁻)

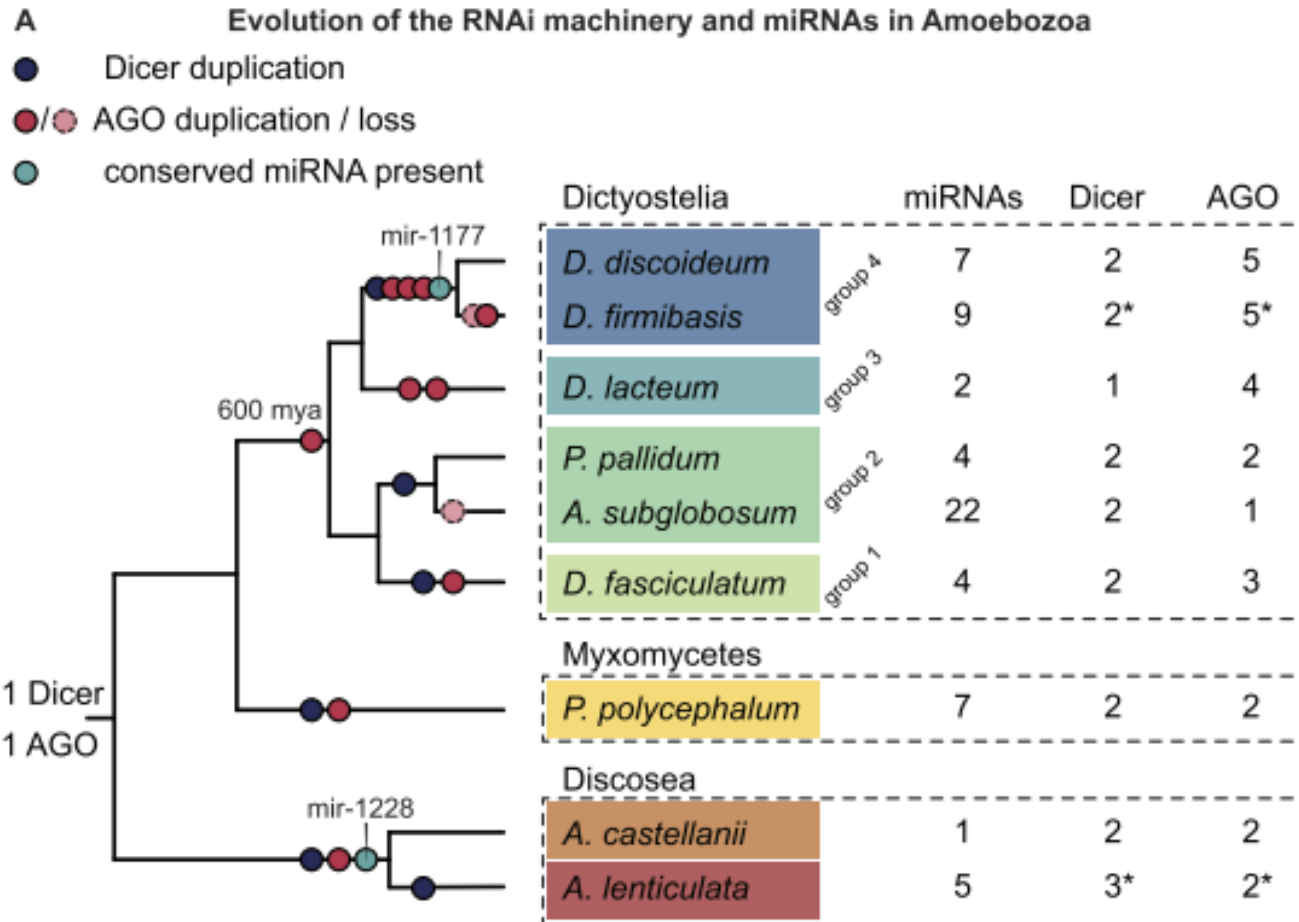


Conservation of miRNA in Acanthamoeba



- Mir-5p and mir-3p sequences well conserved
- Mir-1228 sequences in *A. culbertsoni* have same nucleotide change was *A. healyi*, however, one of the sequences contains 2 or more nucleotide changes in the duplex, predicting additional bulges

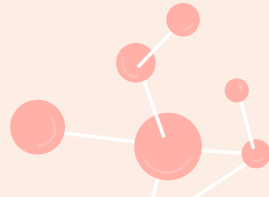
Conservation of RNAi Machinery





Summary

1. Did miRNA's play a role in the evolution of multicellularity (NOT REQUIRED, PLAYED A ROLE)?
 - a. Yes!
 - i. Why: Discovery of mirna in unicellular outgroups to Dictyostelia is analogous to finding miRNA in unicellular organisms of plant and animal lineages
 - ii. Significance: Suggests evolution of colonial multicellularity in P & A + evolution of Aggregative multicellularity in Dictyostelia does not coincide with the evolution of miRNA and miRNA machinery = rapid evolution of amoebozoan mRNA
2. When did miRNA's evolve?
 - a. Previously believed that miRNA's evolved independently in plants and animals, following the expansion of their RNAi machinery
 - i. The data agrees with this partially because of:
 1. Low level of conservation of miRNA, indicates they evolved independently and several times
 2. Expansion of miRNA machinery (dicers and argonautes) simultaneously with the appearance of novel miRNA





Critiques & Future Directions

- Quite valuable! miRNA discovery in social amoeba + unicellular amoeba and further implications for the transition of unicellular to multicellular
- Future directions:
 - *D. discoideum* 5 genes for argonautes
 - Convergent evolution scenario