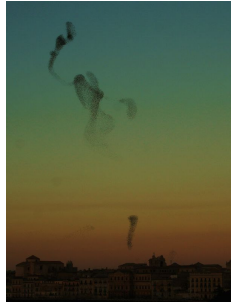


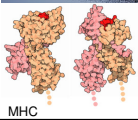
# Animal aggregations and emergent properties

Tuan Cao  
Ecology and Evolutionary Biology  
Ecol-596H  
4/9/2008

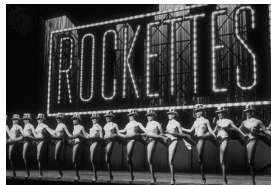


<http://www.movieweb.com/video/V07H78beitABFW>

# Dr. Wayne Potts



MHC

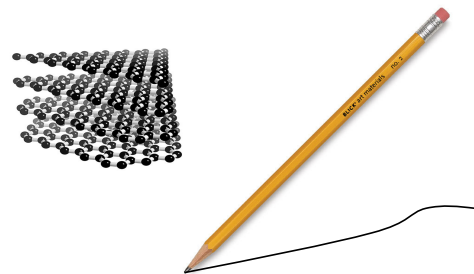
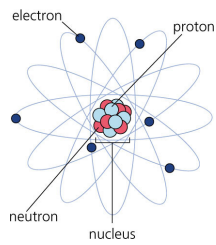
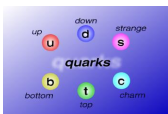


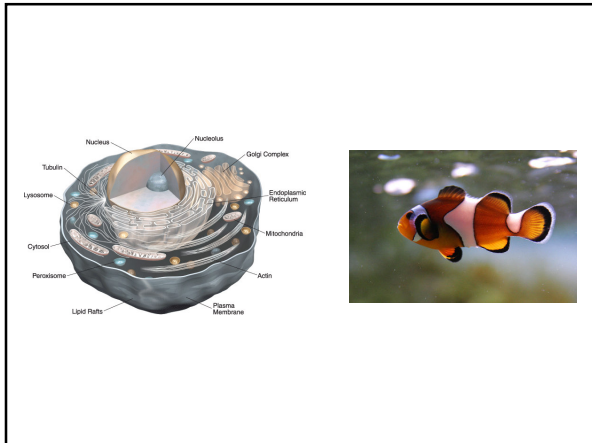
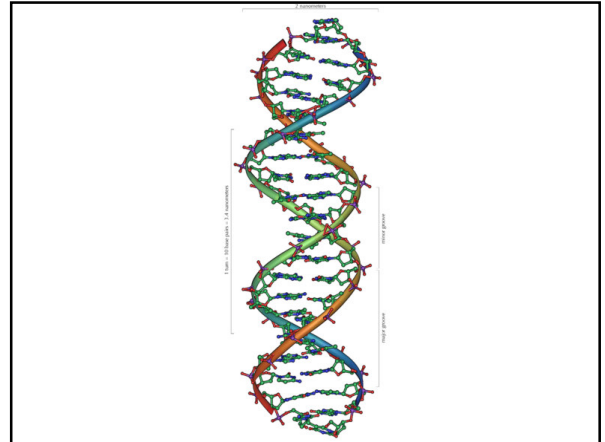
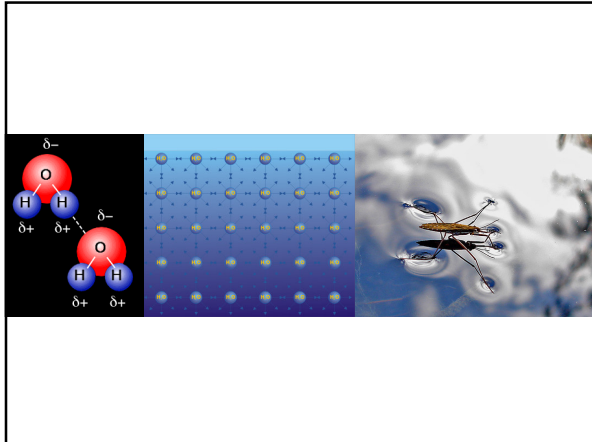
# Emergence

The arising of novel and coherent structures, patterns and properties during the process of self-organization.

Jeffrey Goldstein  
*Emergence: Complexity and Organization*

# Aggregations and emergence at different scales

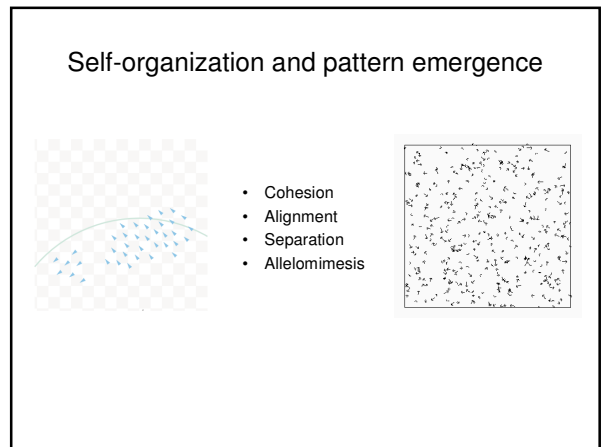
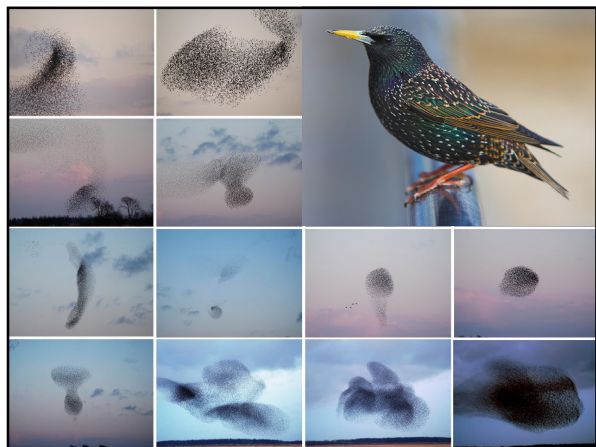
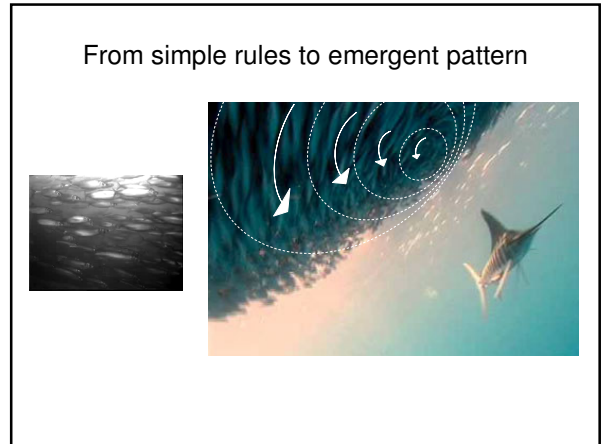
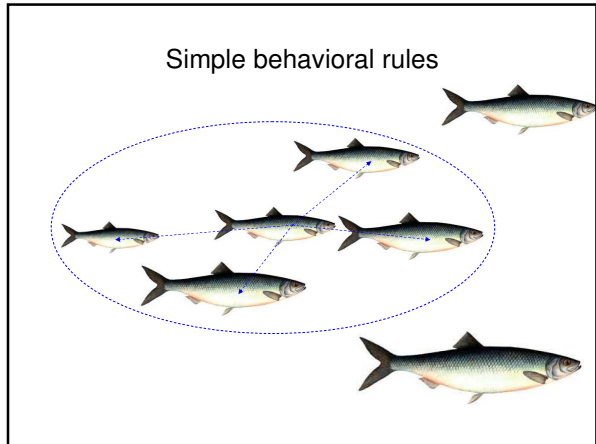




When (dumb) subunits aggregate, emergence is a necessary consequence because there is no central decision maker.

Animal aggregations: pattern and function





## Emergent properties: pattern and function



### Ecology & evolution

#### Why animals aggregate?

##### Darwinian approach

- Fitness benefits
- Evolutionary trade-offs
- Natural selection

### Physics

#### How animals aggregate?

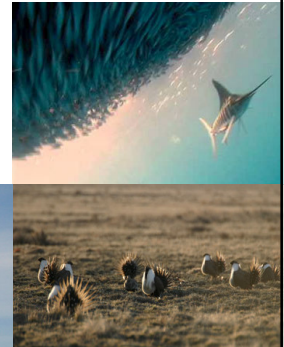
##### Newtonian approach

- Movement rules
- Drag, velocity, distance
- Pattern

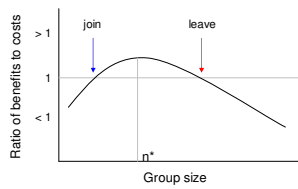


## Why do animals aggregate?

- Protection
- Reproduction
- Energy saving

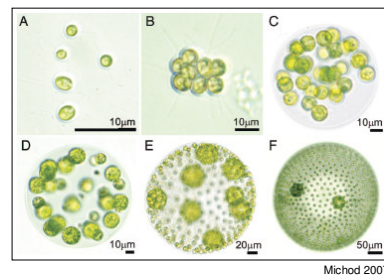


## When to join, when to leave



- Individuals in small groups can make wrong decisions
- Very large groups attracts predators, diseases, pollution
- Selection for optimal group size ( $n^*$ )

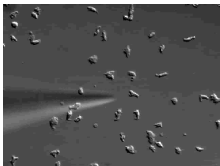
## Groups become individuals



Michod 2007

Valvox video

## Individuals become societies



*Dictyostelium*



## Discussion

- Simple rules can create complex emergent patterns. Useful emergent patterns are (themselves) selected for.
- Because self-organization works, group size/function becomes more important and the individual less. With many, more become dispensable.
- There is selection for optimal group size in social animals.
- [Flock video](#)
- One dumb bird gets eaten. Many birds in a flock yield smart results! Is flocking behavior an example of collective intelligence?

## Emergent clapping 😊

