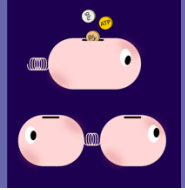
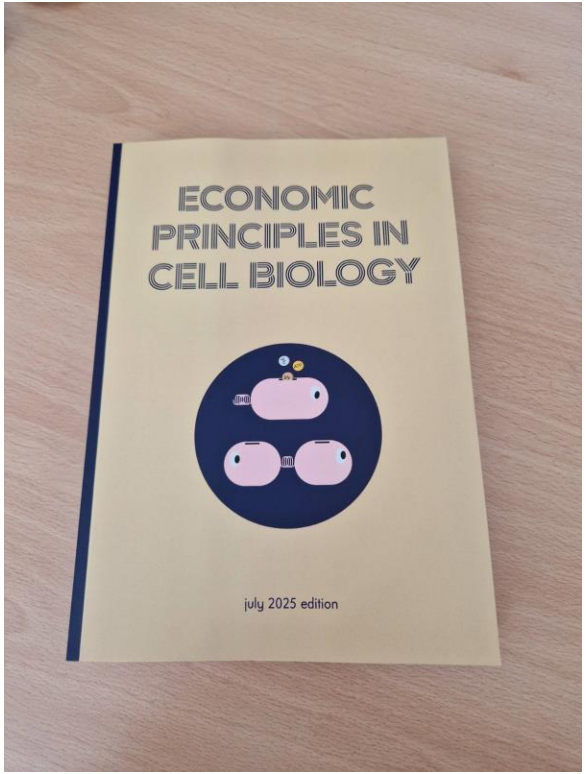


The economy of the cell

Meike Wortel

Collaborative book project



Economic Principles in Cell Biology

What do we mean by Economic Principles?

- Examples?

Economic Principles in Cell Biology

What do we mean by Economic Principles?

- Examples?
- Factory analogy

Restriction to Cell Biology

- Economic Principles in other (biological) disciplines?

Economic Principles in Cell Biology

What do we mean by Economic Principles?

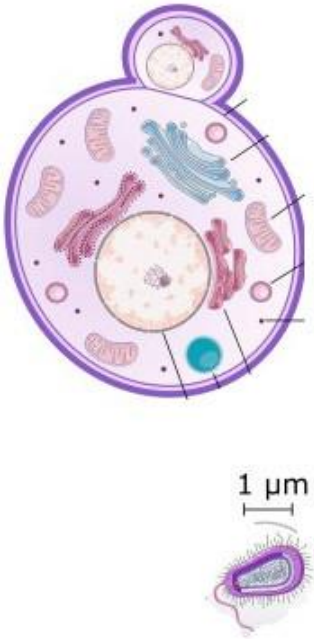
- Examples?
- Factory analogy

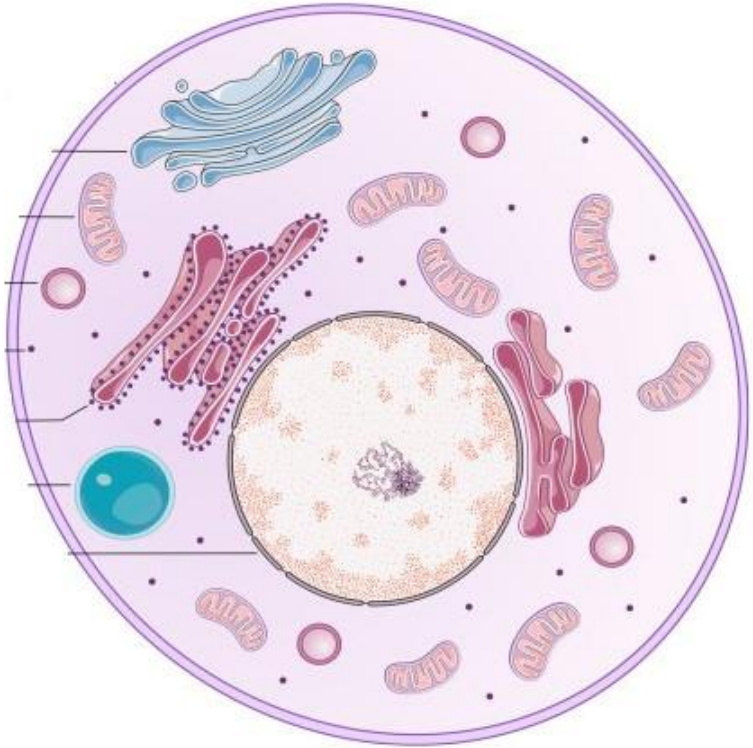
Restriction to Cell Biology

- Economic Principles in other (biological) disciplines?
- Focus on cell biology (some topics concerning cell populations)

Factory analogy

Cell biology

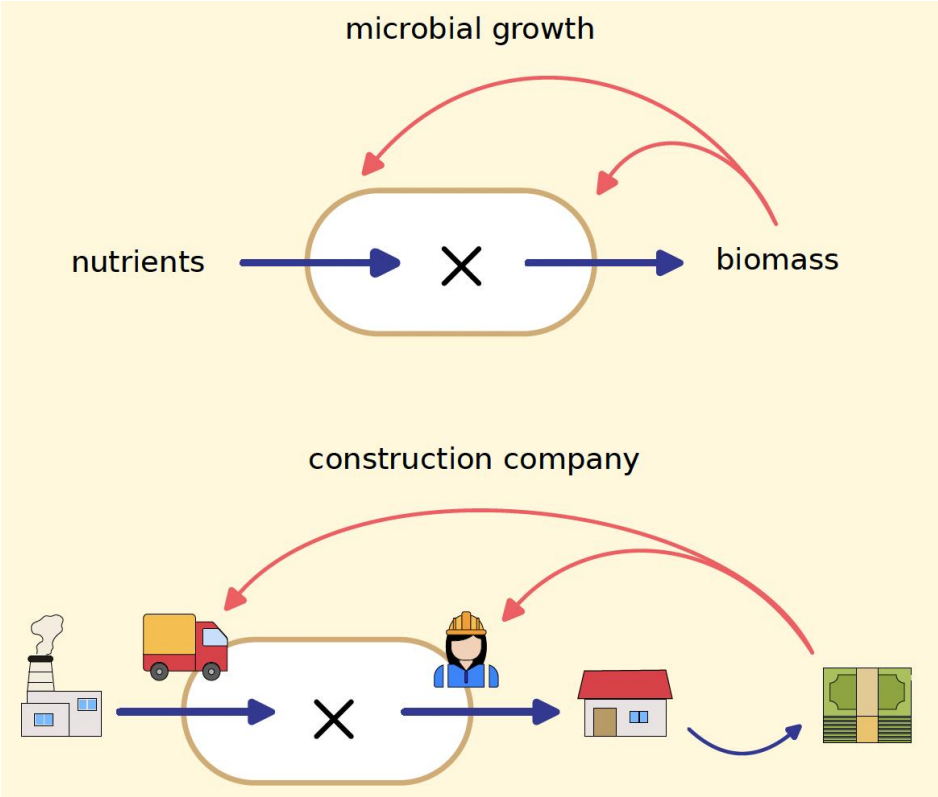




‘Economic’ processes in cells

- **Metabolic pathways**
- **The production of the cell’s energy currency**
- **Resource allocation**
- **Storage and savings**
- **Waste management**
- **Trade and transport**
- **Division of labor**

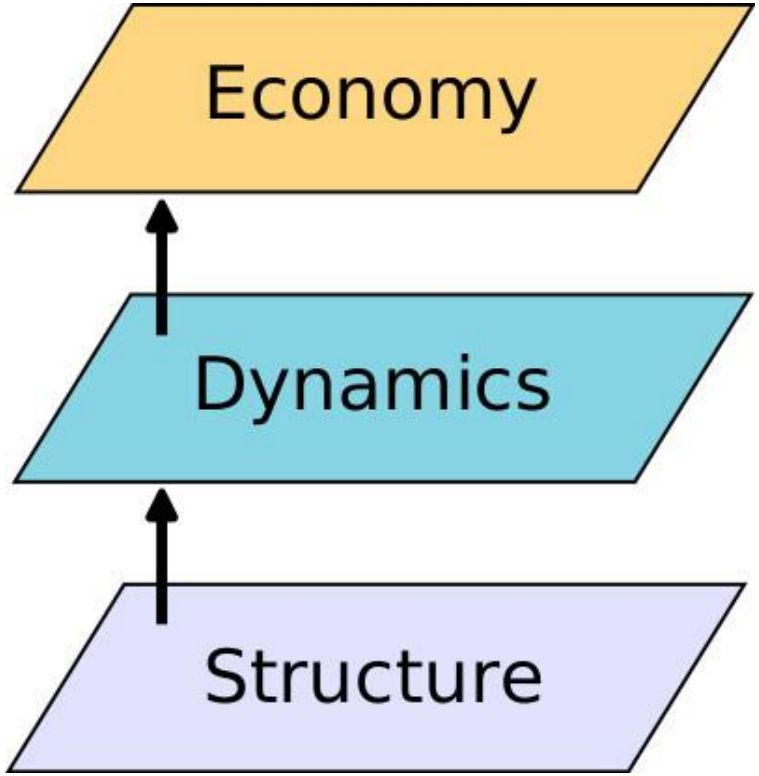
Efficiency of cell processes



- **Constraints:** Diffusion, cell size
- **Costs:** Enzymes, nutrients, toxic metabolites
- **Benefits:** Biomass production

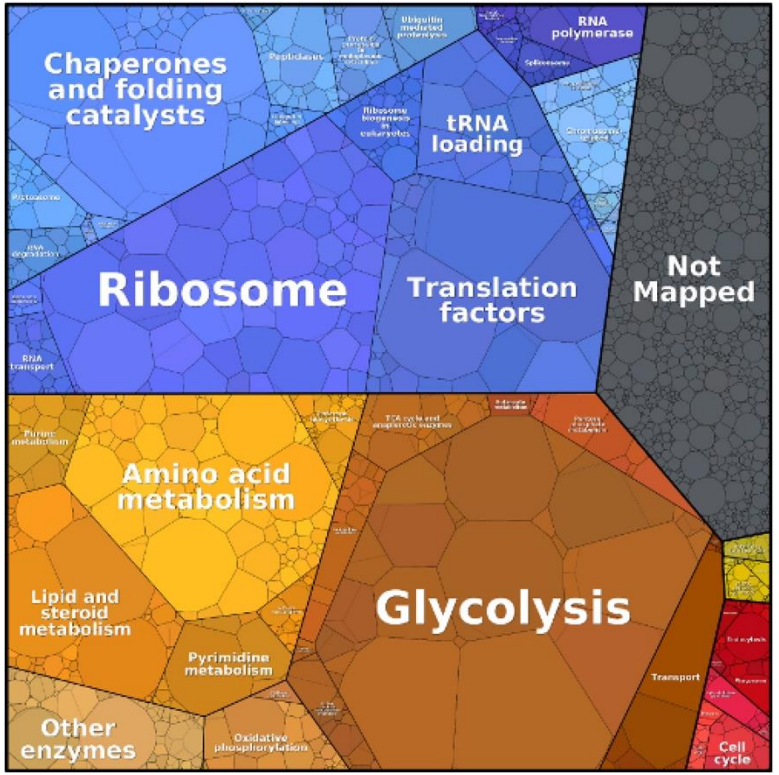
- **Constraints:** Working hours
- **Costs:** Personnel, materials, machines
- **Benefits:** Revenue

Levels of description of cellular conversions



Two answers to the ‘why question’

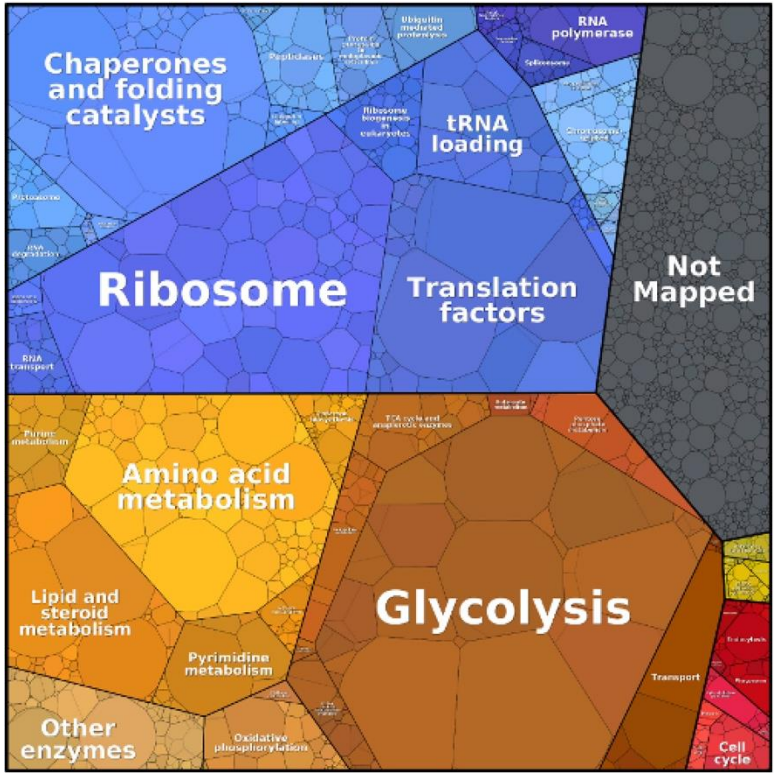
“Why do cells use a large fraction of the proteome for glycolysis?”



Two answers to the ‘why question’

“Why do cells use a large fraction of the proteome for glycolysis?”

1. Because glucose is sensed, a signalling cascade is activated, and glycolytic enzymes are produced
“Proximate explanation”

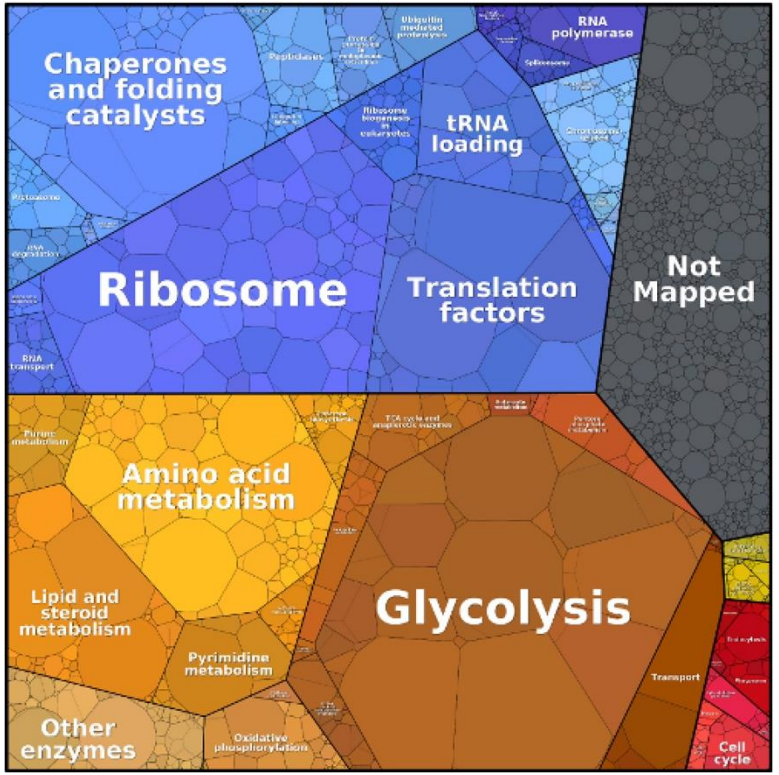


Two answers to the ‘why question’

“Why do cells use a large fraction of the proteome for glycolysis?”

1. Because glucose is sensed, a signalling cascade is activated, and glycolytic enzymes are produced
“Proximate explanation”

2. Because with less investment in glycolysis, a lack of precursors and energy for biomass production leads to slow cell replication and replacement by competitors
“Ultimate explanation”

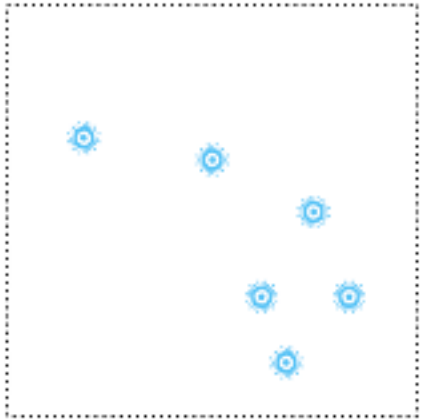


Cells as thinking beings?

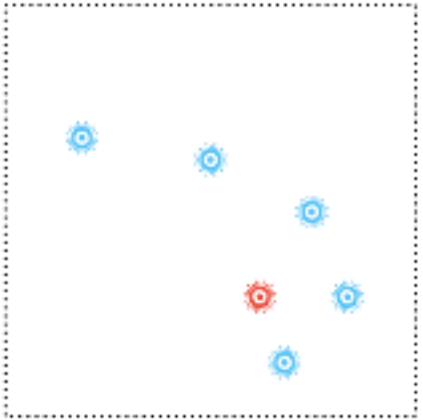
”Bacteria make osmolytes to survive at high salt concentrations”

“The objective of the cell is to grow fast”

Growth in well-mixed environment



Growth in well-mixed environment



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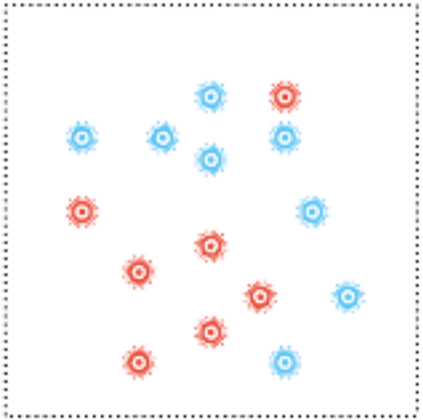
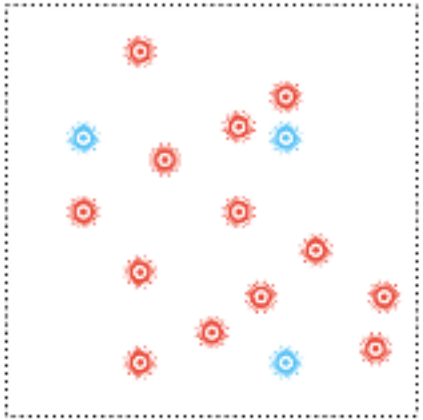
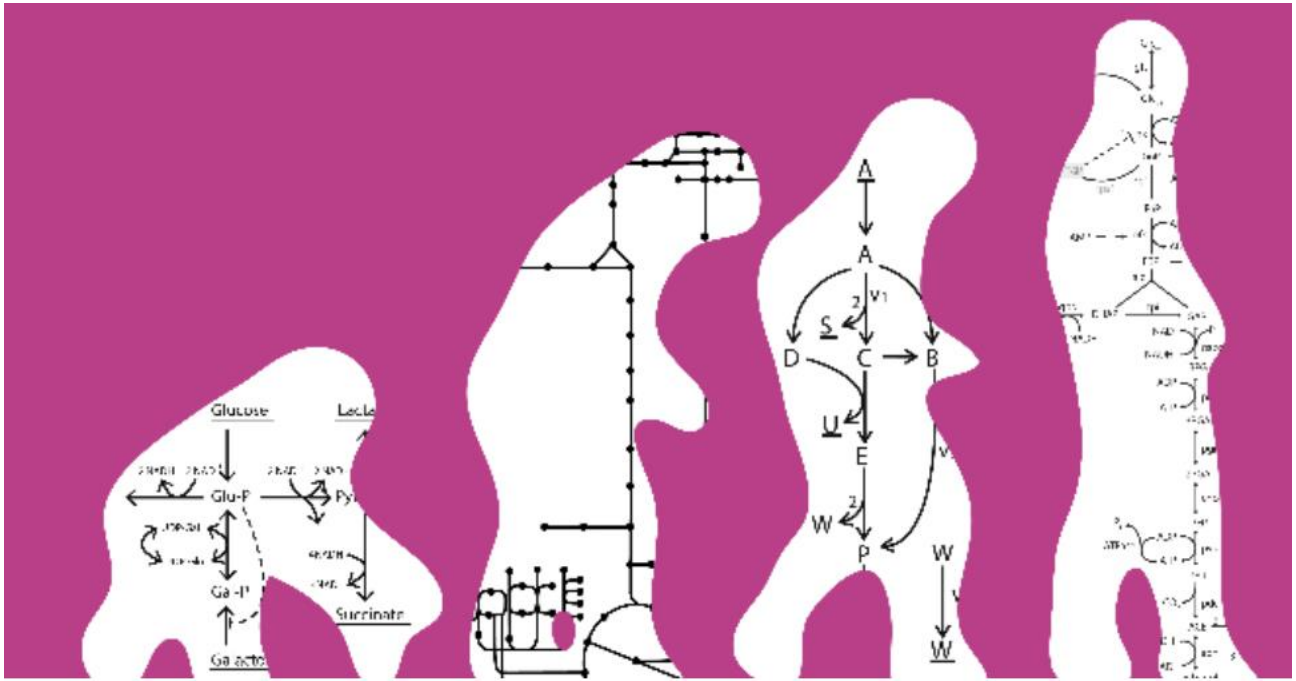


Growth in well-mixed environment



Many cellular properties contribute to growth

Optimisation is a continuous process and conditions may be changing



‘Economic’ view of cells to understand cellular behaviour