The big picture summary; modelling; patterns

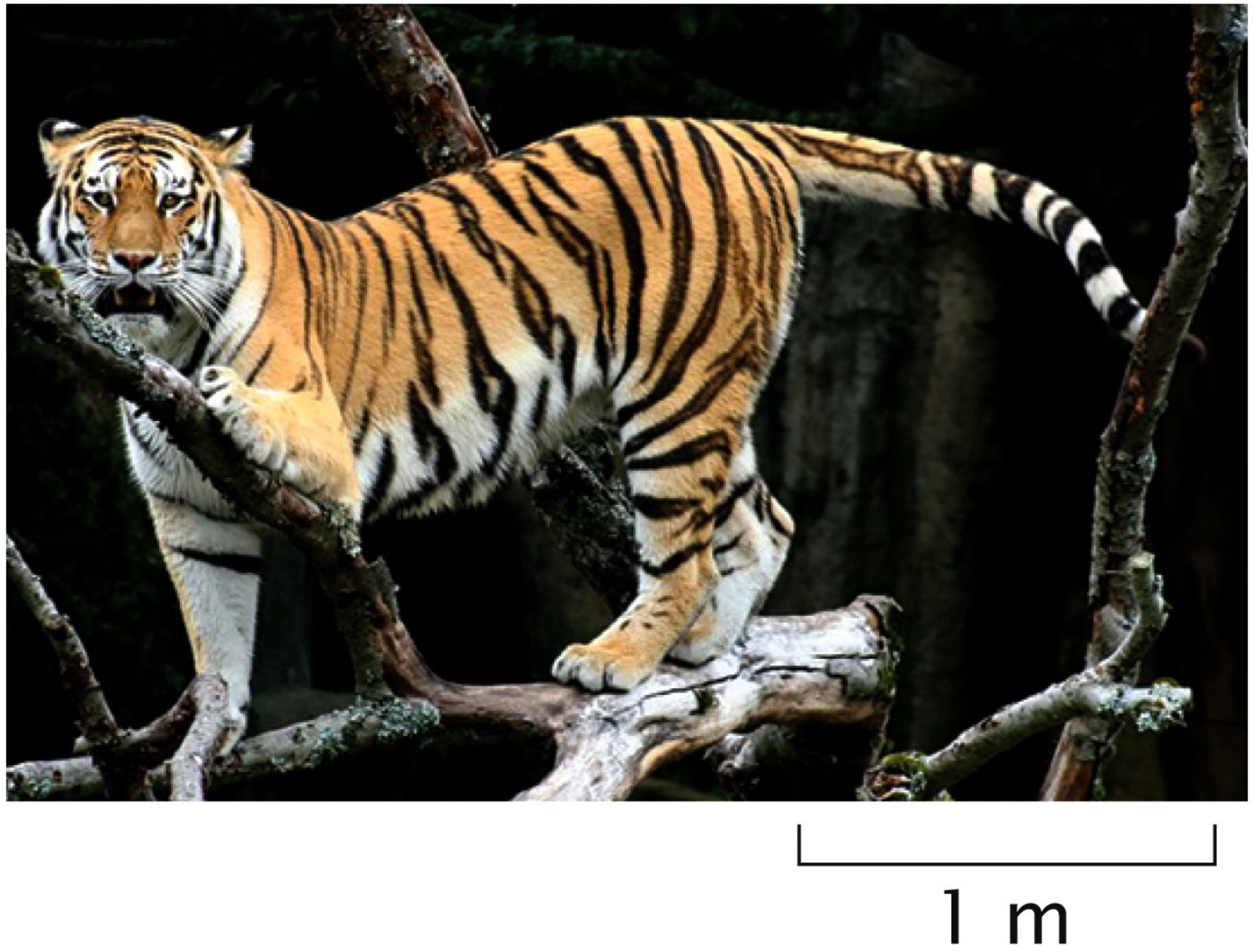

Figure 20.1d Physical Biology of the Cell, 2ed. (© Garland Science 2013)

Figure 20.1e Physical Biology of the Cell, 2ed. (© Garland Science 2013)

Summary and big picture

We want to predict the “future”: predicting what happens after a time t?

Equilibrium: what happens after infinite time?

(Forces/flows balance)

If temperature has no role, after infinite time, of the system will be found at the minimum of the potential energy

What is the dynamics? How does it reach it to the minimum? When?

“Dead objects” with no role of temperature: Newton’s equations

“Dead objects” with temperature: Beyond Newton’s equations

Objects at finite temperature: effect of thermal fluctuations

Dead objects with temperature.
Equilibrium => statistical
mechanics or thermodynamics

Dead objects with temperature. Equilibrium => statistical mechanics or thermodynamics

Systems go to the minimum of the free energy: energy and entropy plays a role

Dead objects with temperature. Equilibrium => statistical mechanics or thermodynamics

Systems go to the minimum of the free energy: energy and entropy plays a role

Boltzmann distribution

“Dead objects” with temperature: Dynamics: time-dependent changes

Langevin equation = Newton’s equation + effect of temperature

$$m\frac{dv}{dt} = -\alpha v + f + f_{\text{random}}$$

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Choose random force such that

Mean of random force = 0

Variance of the random force is proportional to temperature

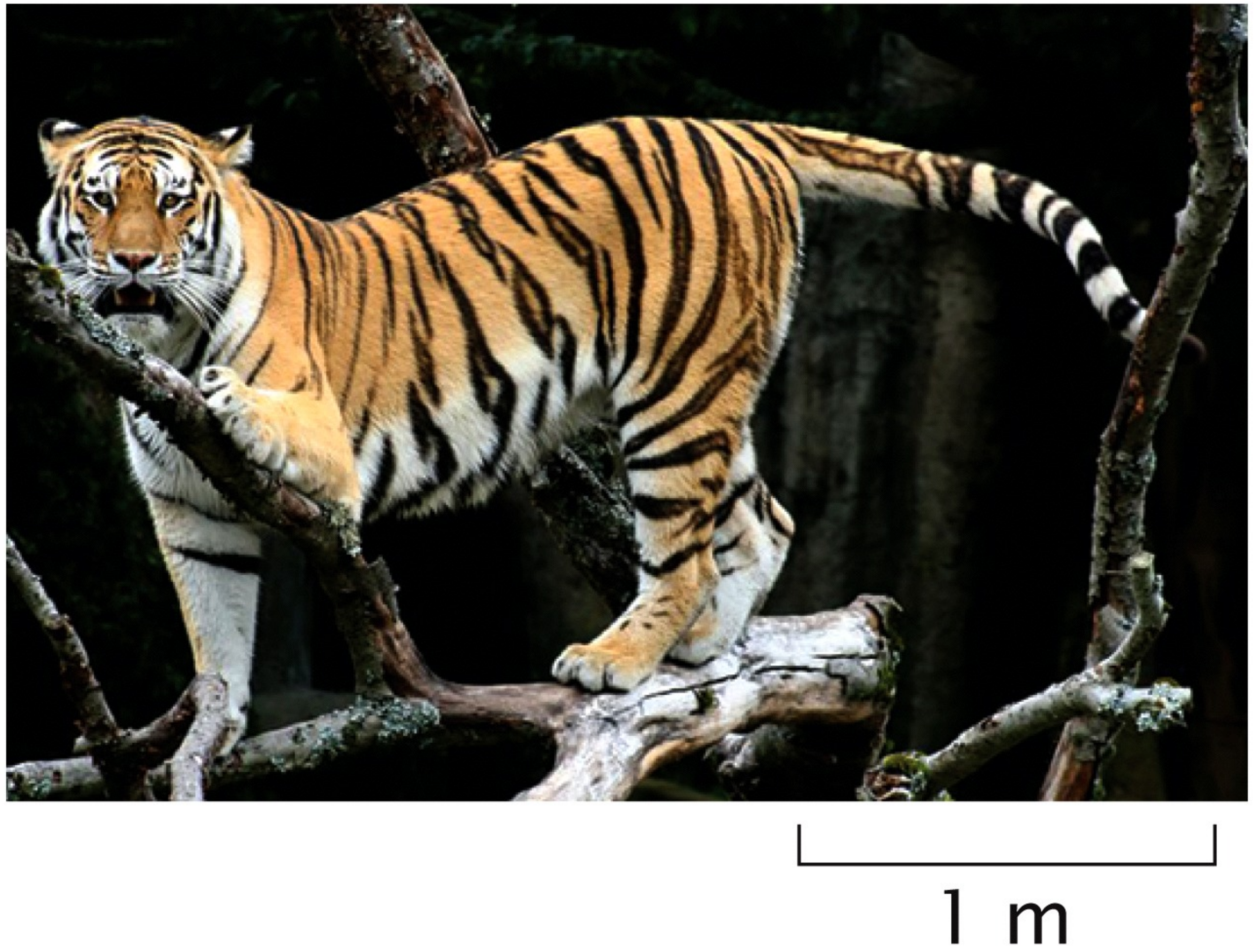
Equivalent way is to write equations for probability distributions

How probability distribution of states change with space and time

Diffusion: How probability distribution (concentration) of particles change with space and time

Reaction-diffusion

Production of material and reaction diffusion leads to patterns



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