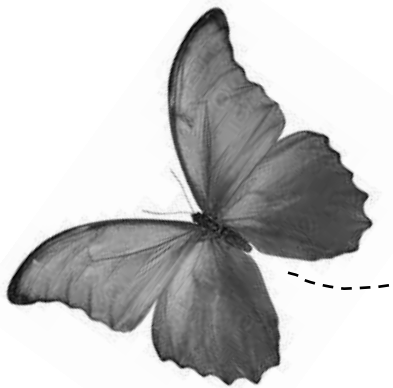


$dx/dt = x_2 - x_1$

Mathematical modeling in biology

From mere observation to manipulation

Biology relies on experiments, observation and data

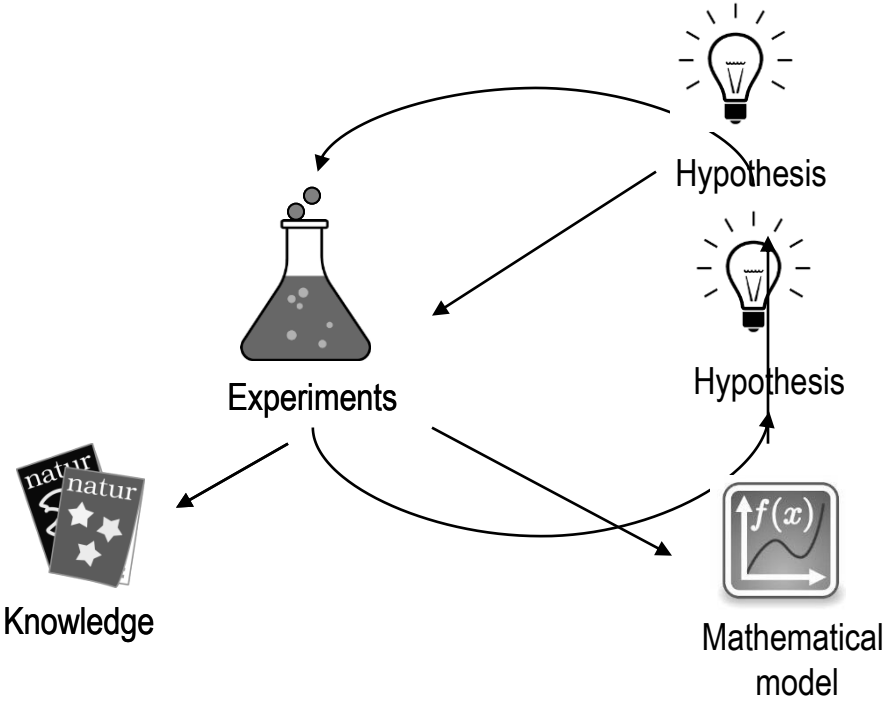
Sometime observations are not good enough

- Some experimental observations do not give clear physical explanation of a phenomenon
- Sometime experiments are not feasible.
- Sometime experimental results are too large/complicated to understand intuitively

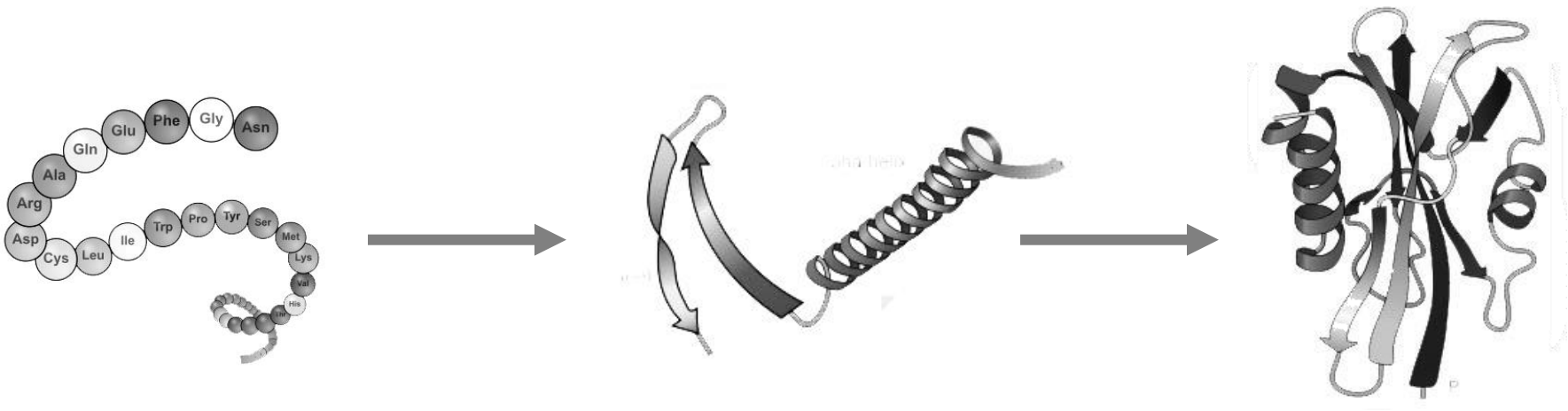
Mathematical models:

- Help to give physical explanation of a phenomenon
- Help in making prediction
- Help in creating hypothesis

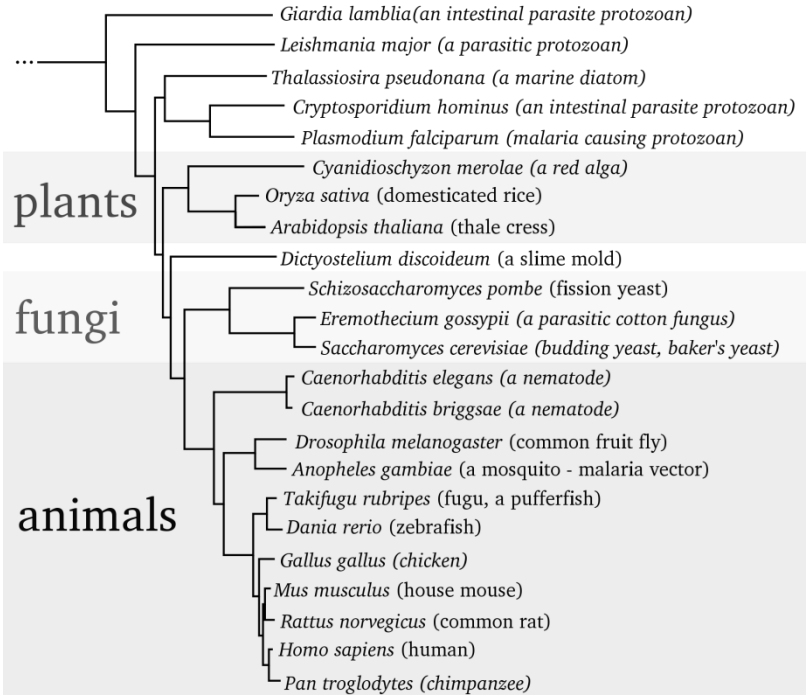
The cycle of science



Modeling a protein structure



Modeling to find the ancestor



Our focus: Modeling Dynamics

Biological processes are not static. Those are dynamic, & changing with time

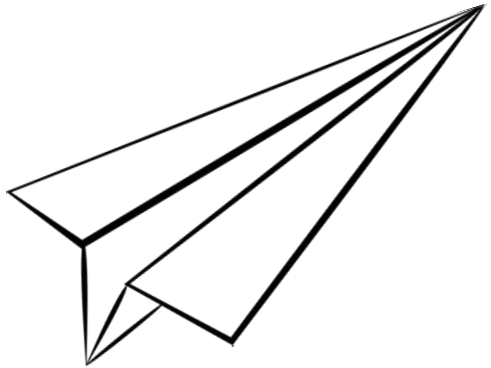
- Number of predators and prey in an ecosystem
- Migration of animals
- Spread of disease
- Growth of bacteria in fermenter
- Growth our body
- Pattern formation
- Control of our sleep cycle
- Dynamics of hormonal cycle
- Cell division
- Migration of cell
- Gene-expression
- Signal transduction
- Metabolism

We want to model time dependent changes/processes

A paper plane is not a plane

Models are simplified representation of reality

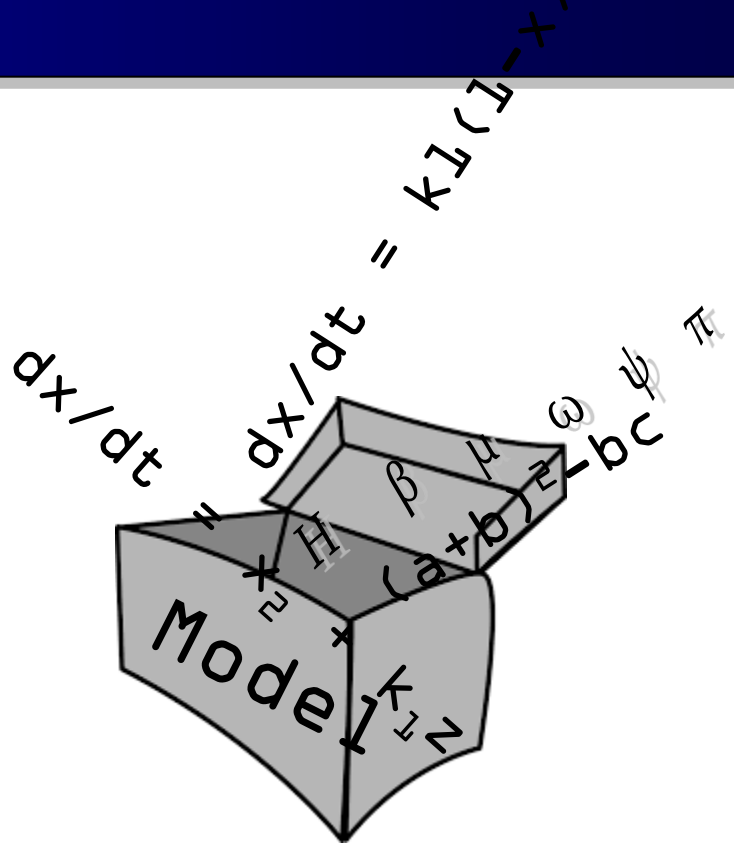
Models answer specific questions



Inside the box

• Mathematical models are sets of mathematical constructs, based on physical principles and observations.

• We get answers to our questions by analyzing (simulating) the model



Key points:

1. Mathematical models are common in biology
2. Mathematical models complements experimental observations
3. We will focus on modeling dynamics of biological systems
4. A model is a reduced representation of reality
5. Mathematical models are sets of mathematical constructs. We analyze those to get answers to our questions.