



## Bayes' theorem

$$\begin{array}{c} \text{posterior} \end{array}
 \begin{array}{c} \text{likelihood} \end{array}
 \begin{array}{c} \text{priors} \end{array}
 P(\text{parameters} \mid \text{data, model}) = \frac{P(\text{data} \mid \text{parameters, model}) P(\text{parameters} \mid \text{model})}{P(\text{data} \mid \text{model})}$$

marginal probability of the data

## Putting everything together

$$\begin{array}{c} \text{posterior} \end{array}
 P(\text{Tree, } \lambda, \mu, \rho, \text{Substitution, Clock} \mid \text{Data, Flower}) =$$

probability of the character  
data given everything else\*

$P(\text{Data} \mid \text{Tree, } \lambda, \mu, \rho, \text{Substitution, Clock})$

probability of the timetree  
given the tree model

$P(\text{Tree} \mid \text{Flower})$

priors on model parameters

$P(\lambda) P(\mu) P(\rho)$

$$\frac{P(\text{Data} \mid \text{Tree, } \lambda, \mu, \rho, \text{Substitution, Clock}) P(\text{Tree} \mid \text{Flower}) P(\lambda) P(\mu) P(\rho)}{P(\text{Data} \mid \text{Flower})}$$

marginal probability of the data

\*the tree, the parameters and the tripartite model