

## High-D Substrate

$$X \in \mathbb{R}^D$$

*asymmetric  
(low symmetry)*

$\Phi$



## Low-D Representation

$$Y = \Phi(X) \in \mathbb{R}^k$$

*dimensional  
reduction*

$Q$



## Heat Bath

$$T$$

*entropy  
increase*

$$W_{\text{diss, min}} \geq k_B T (\ln 2 \Delta I + C_\Phi)$$

$\Delta I$ : information removed

$C_\Phi$ : geometric contraction cost