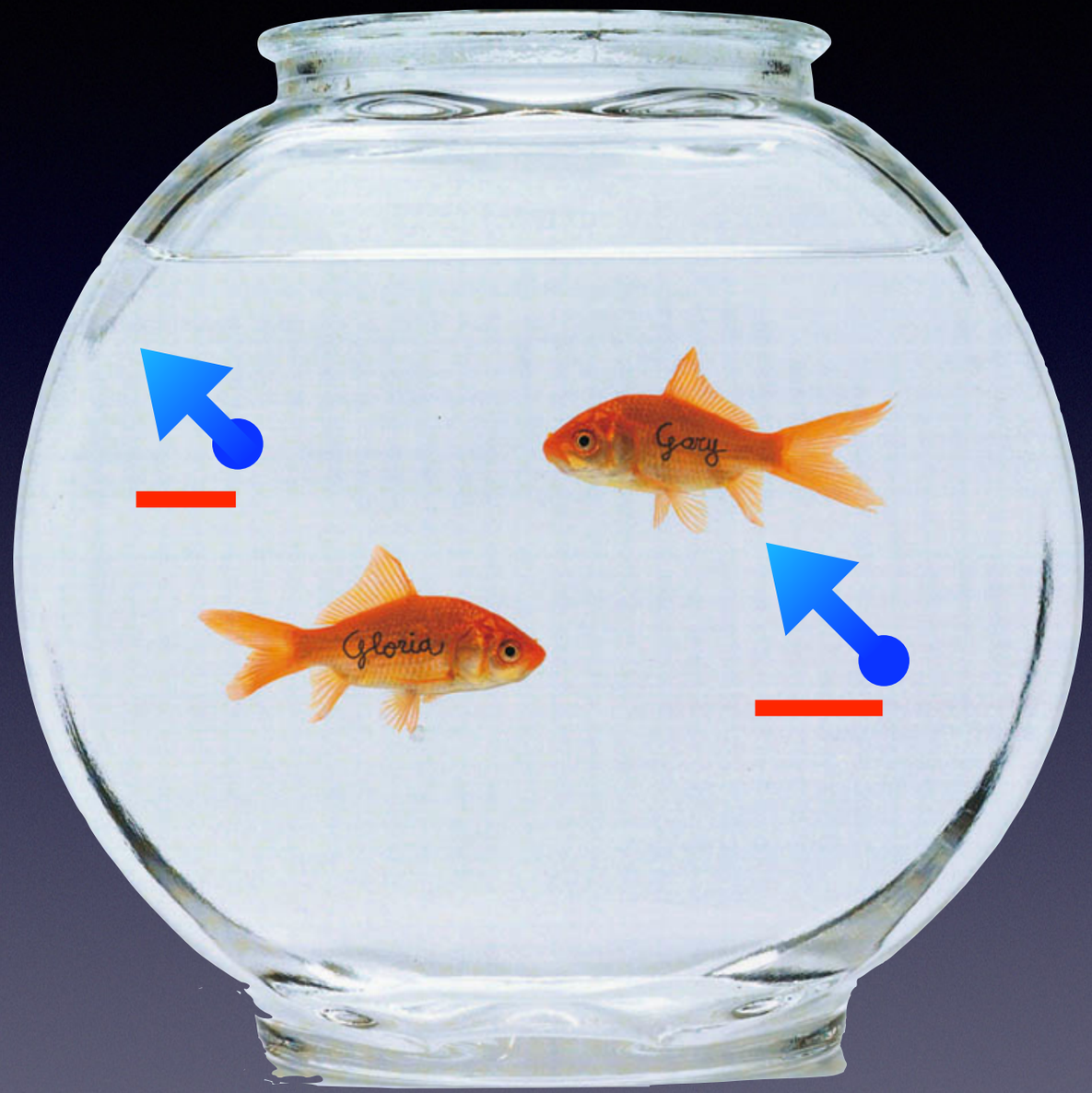
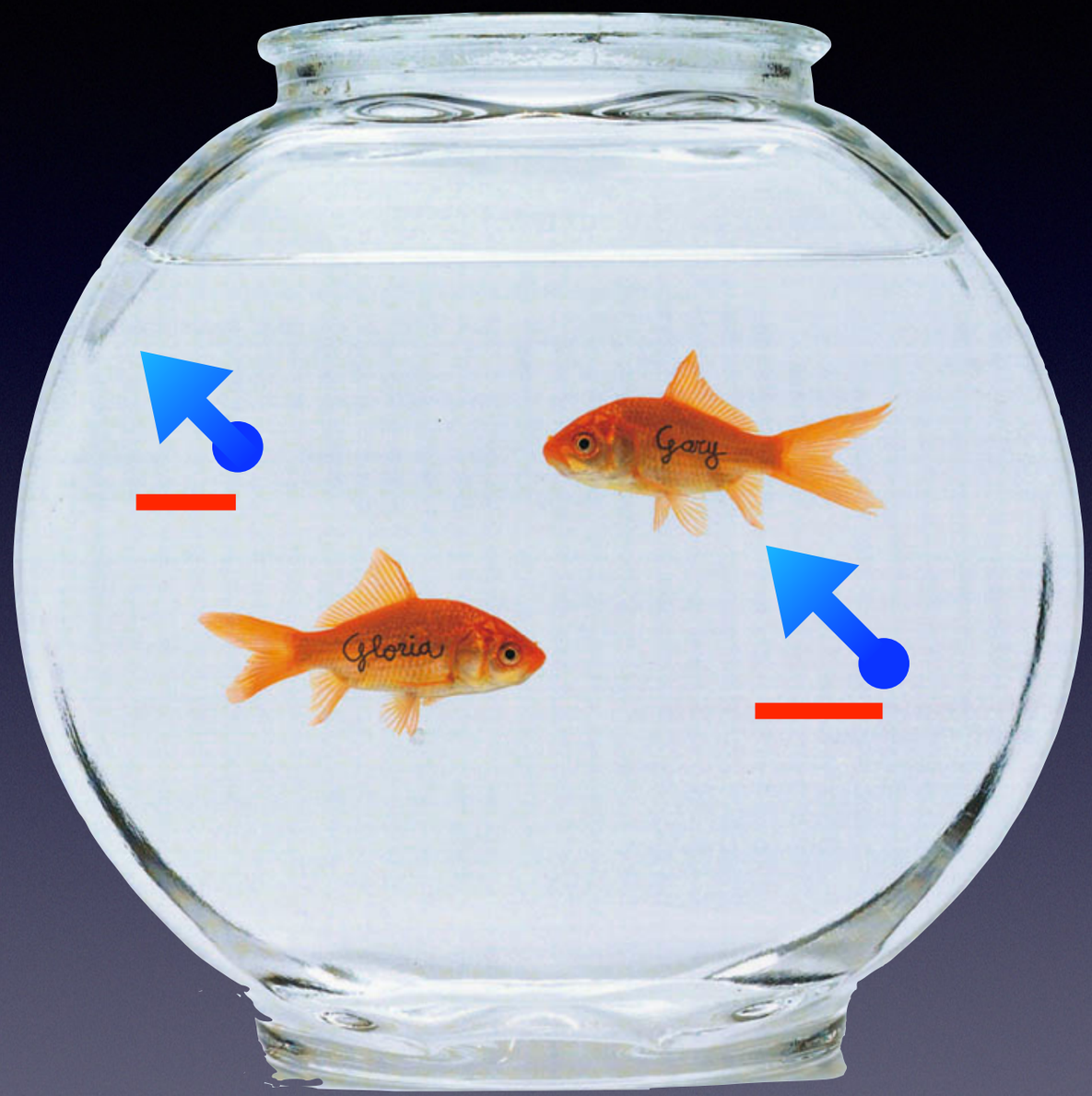
A Non-Physicist's Intro to Diffusion MRI

Dylan Tisdall

Diffusion

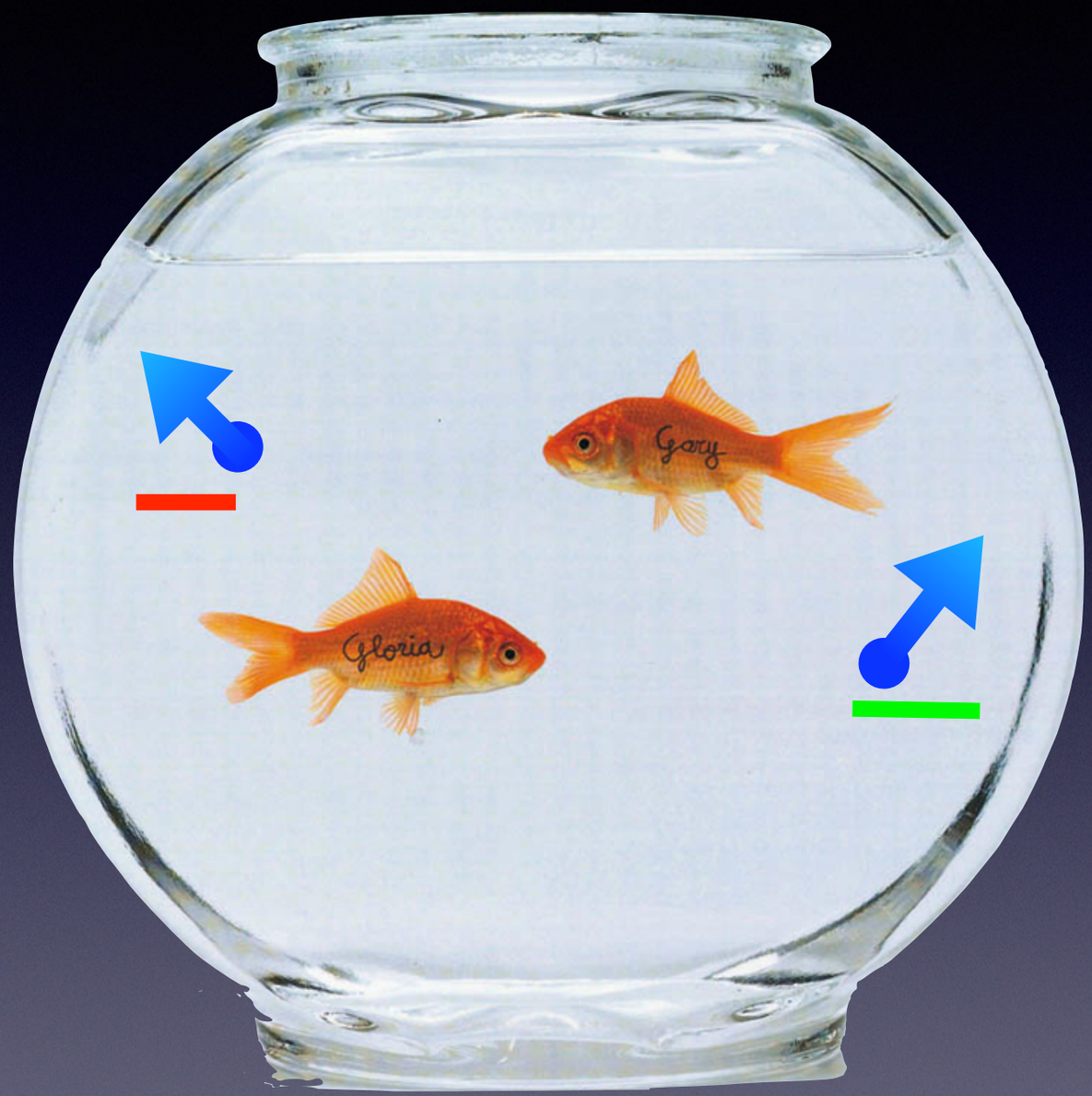


Diffusion



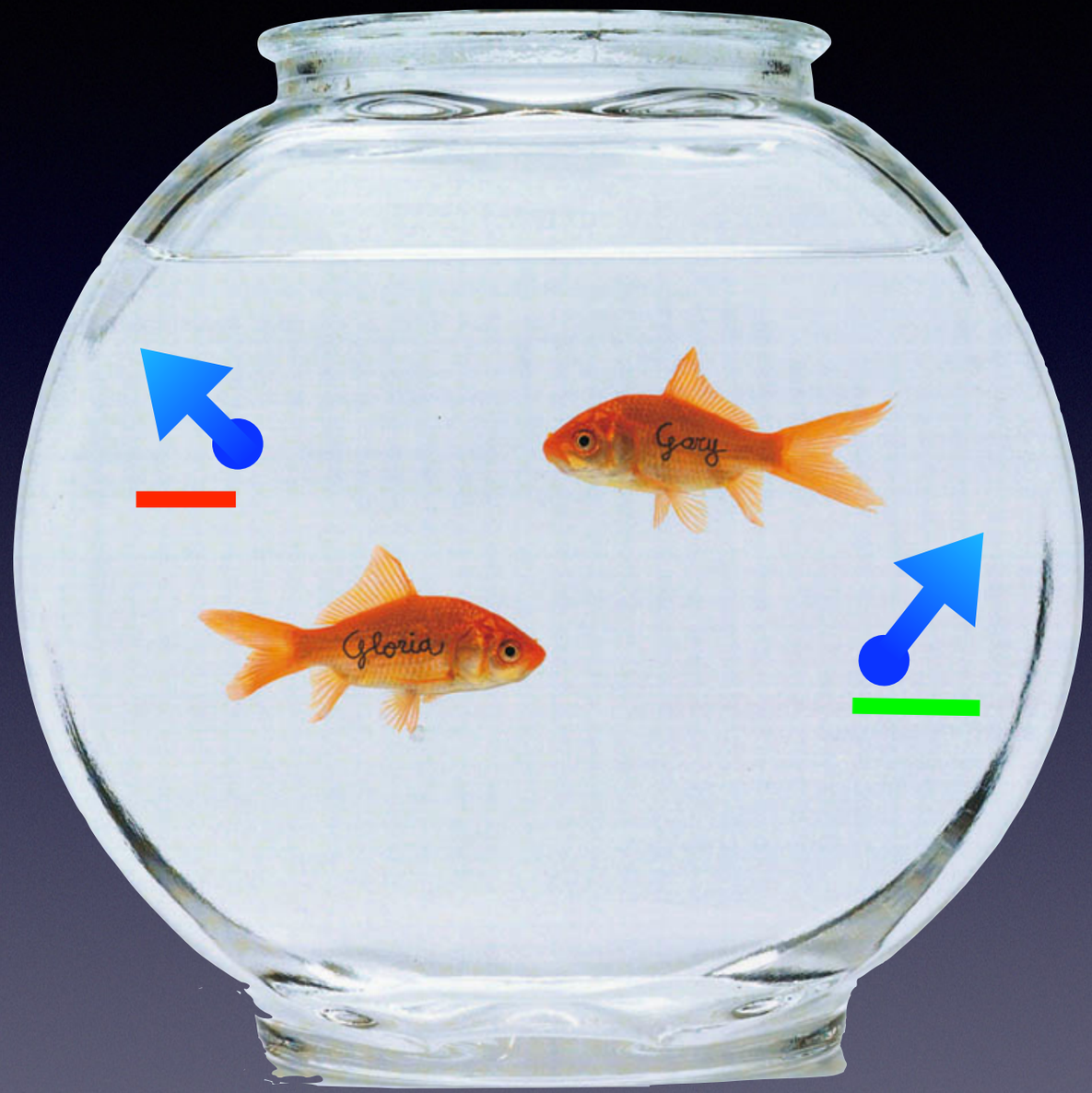
gradient

Diffusion



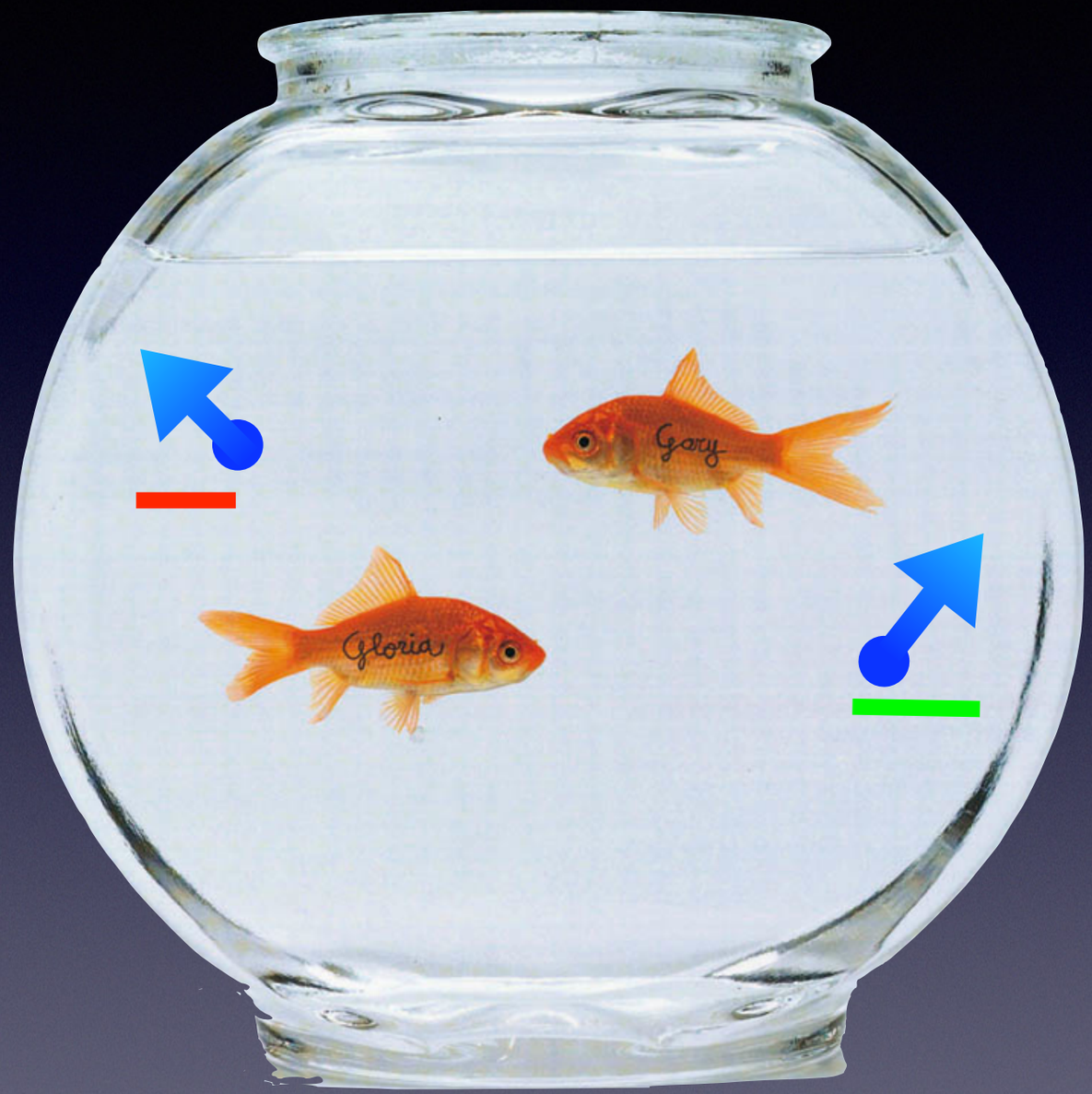
gradient

Diffusion



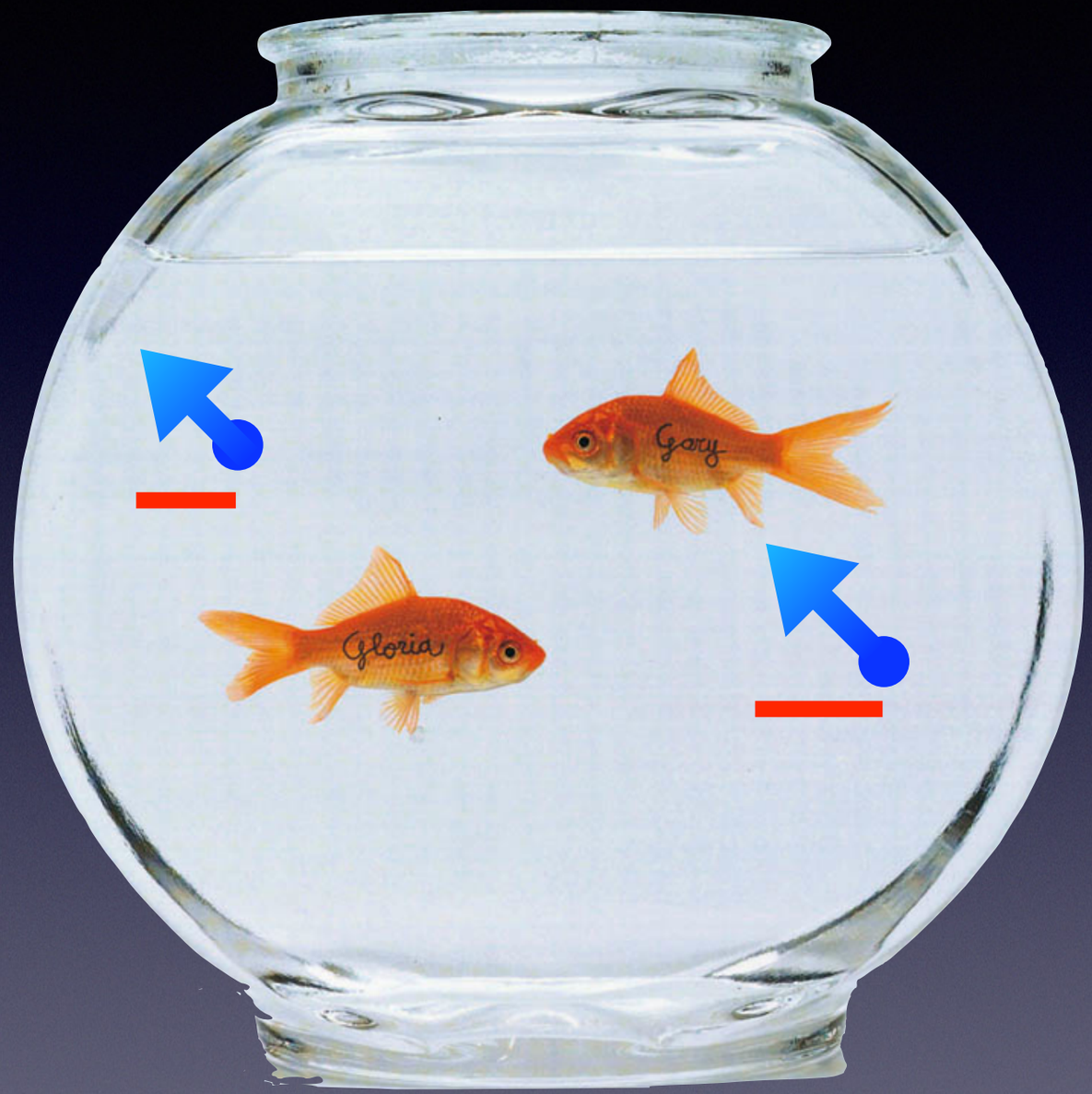
no gradient

Diffusion



opposite gradient

Diffusion



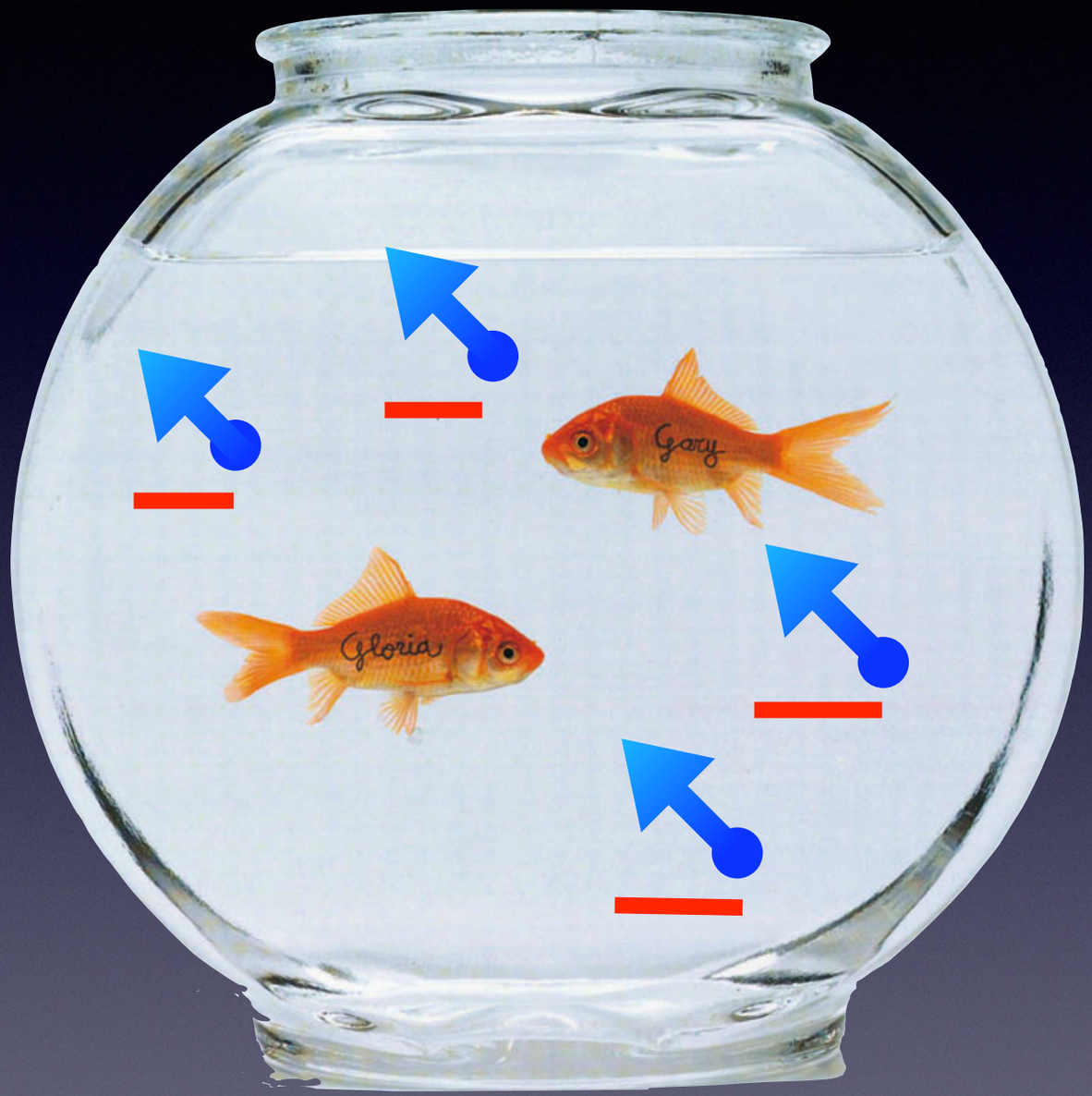
opposite gradient

Water molecules diffuse (move) inside of all tissues.

At 37 C, water has a diffusion rate of 3×10^{-3} mm^2/s.

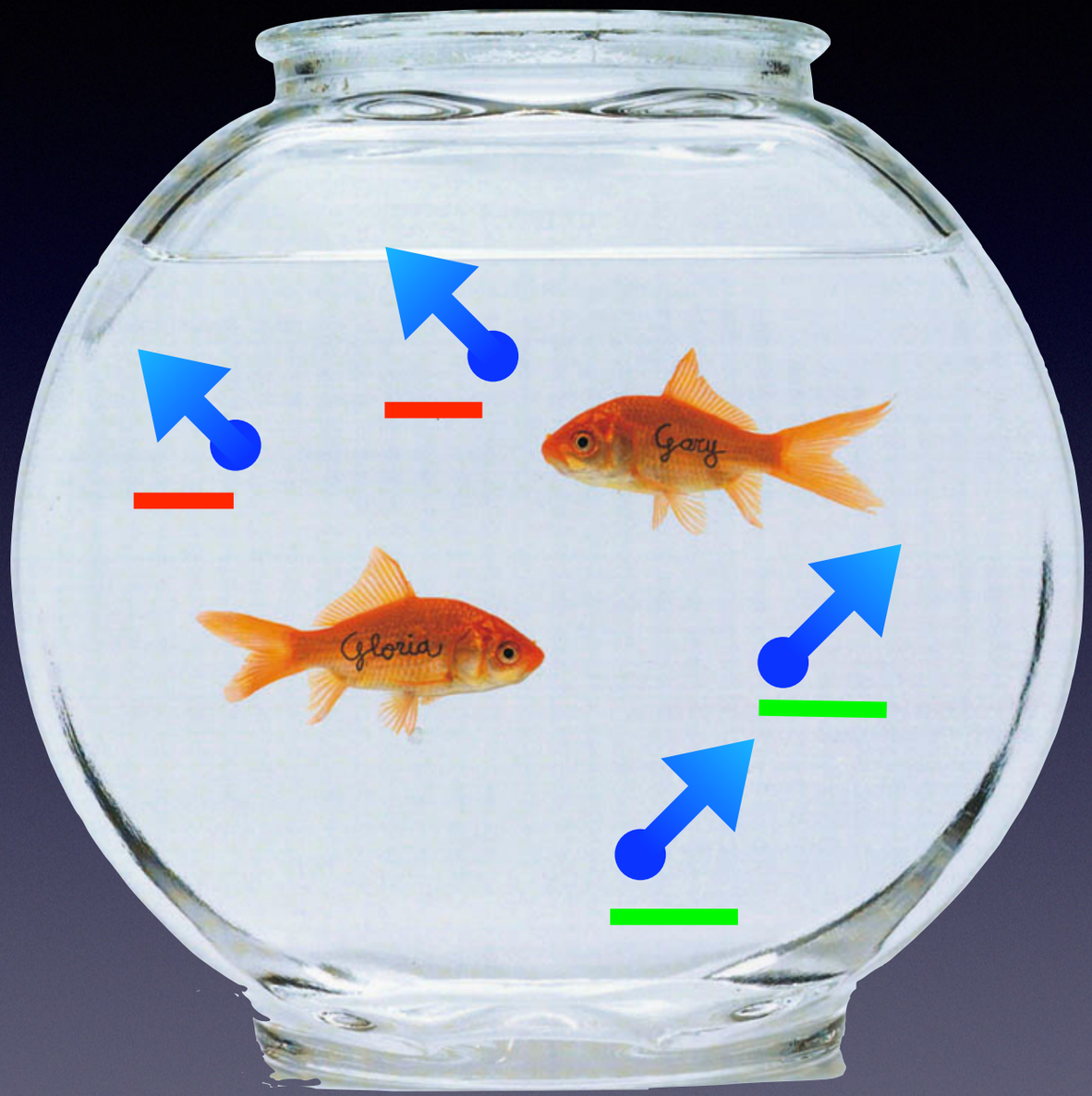
We expect a displacement of about 17 μm in 50 ms

Diffusion



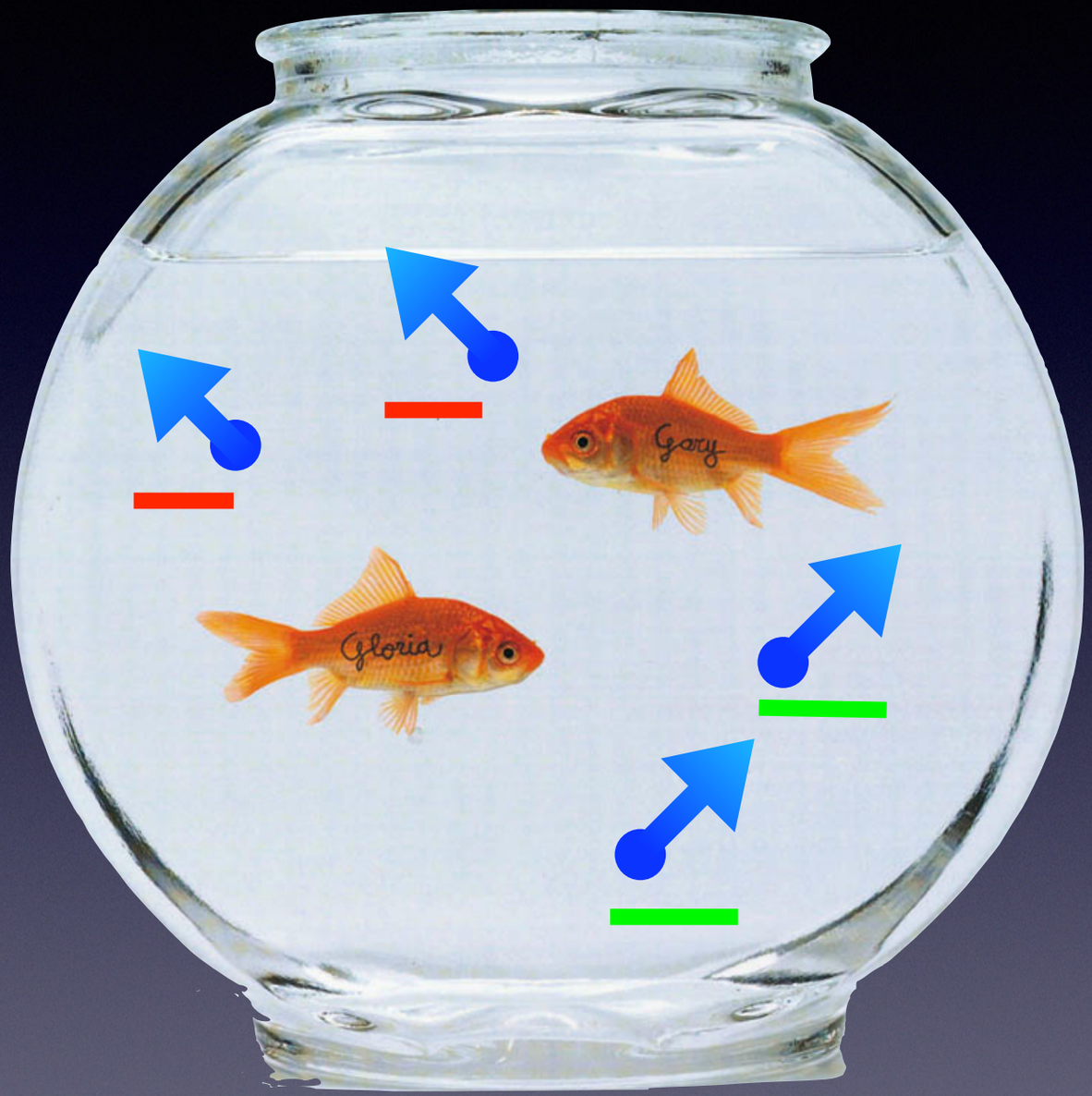
gradient

Diffusion



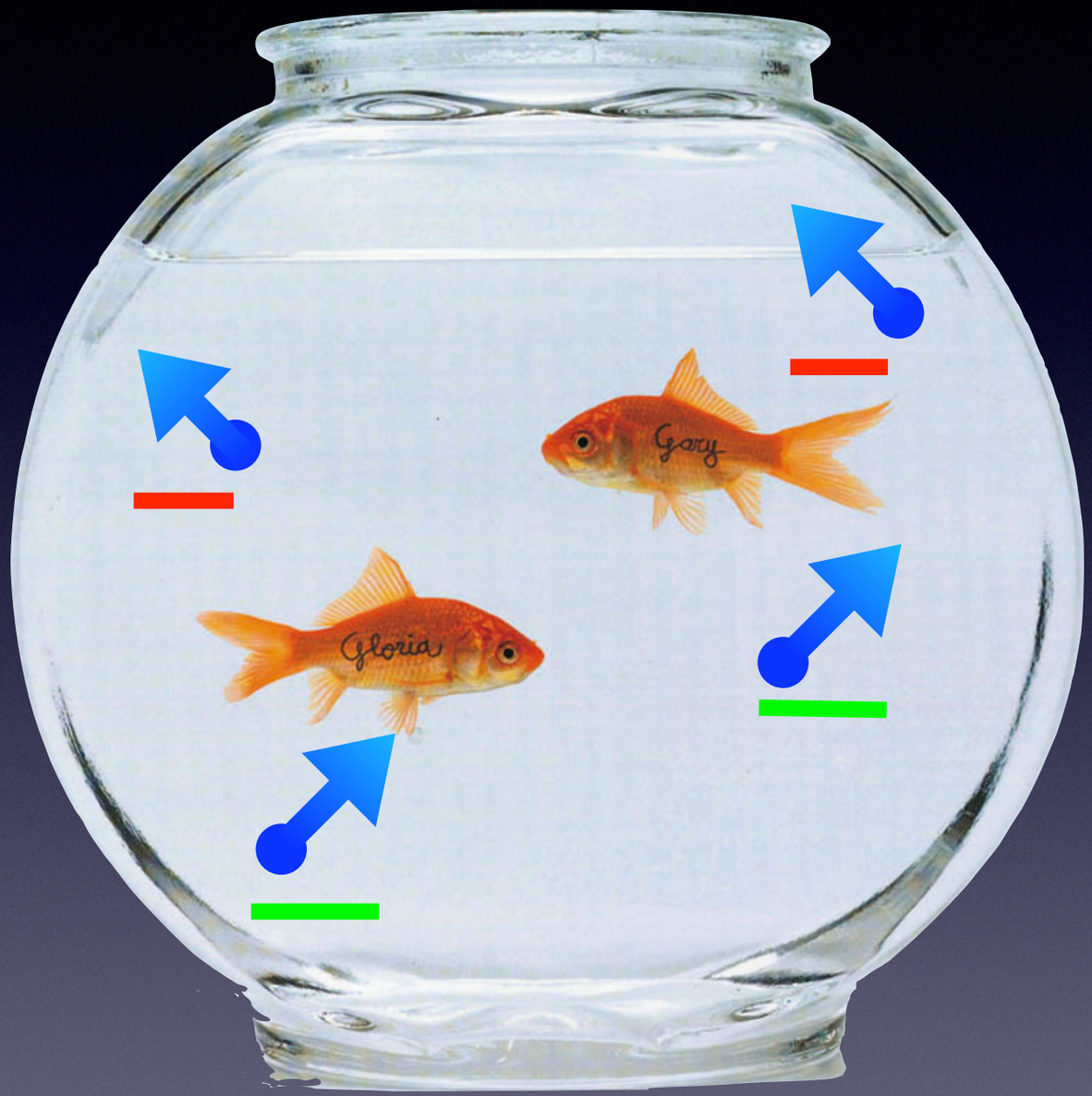
gradient

Diffusion



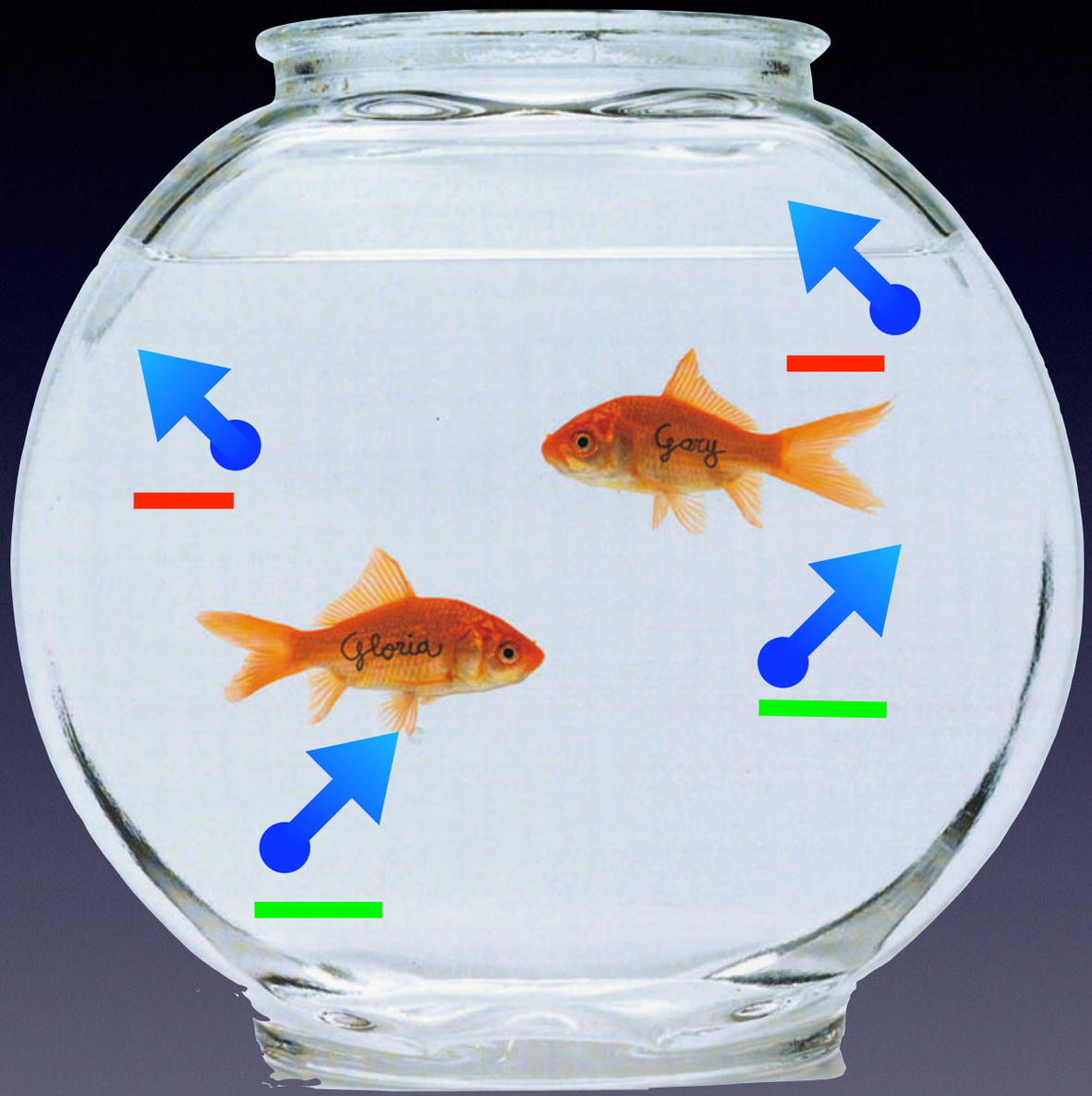
no gradient

Diffusion



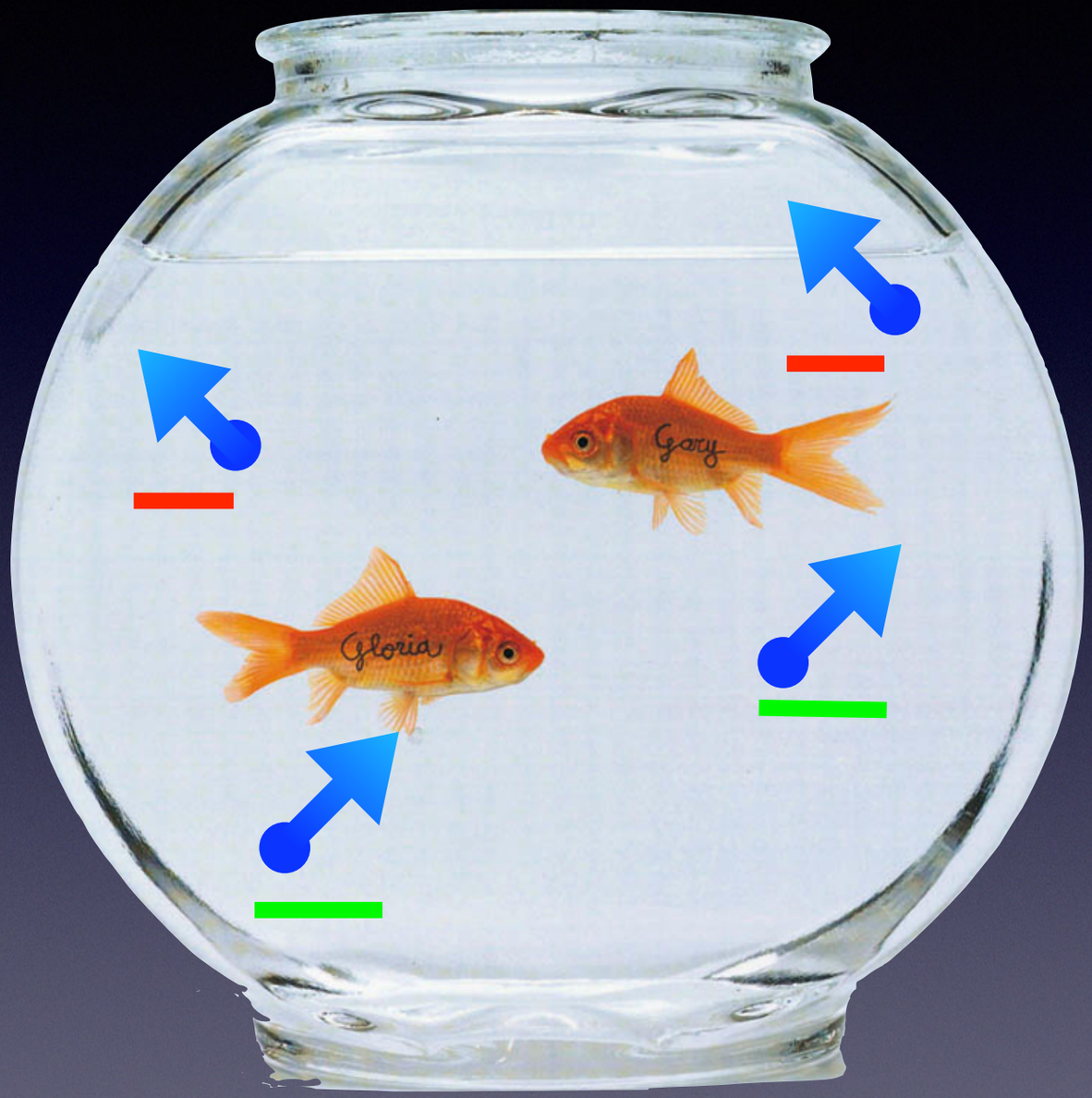
no gradient

Diffusion



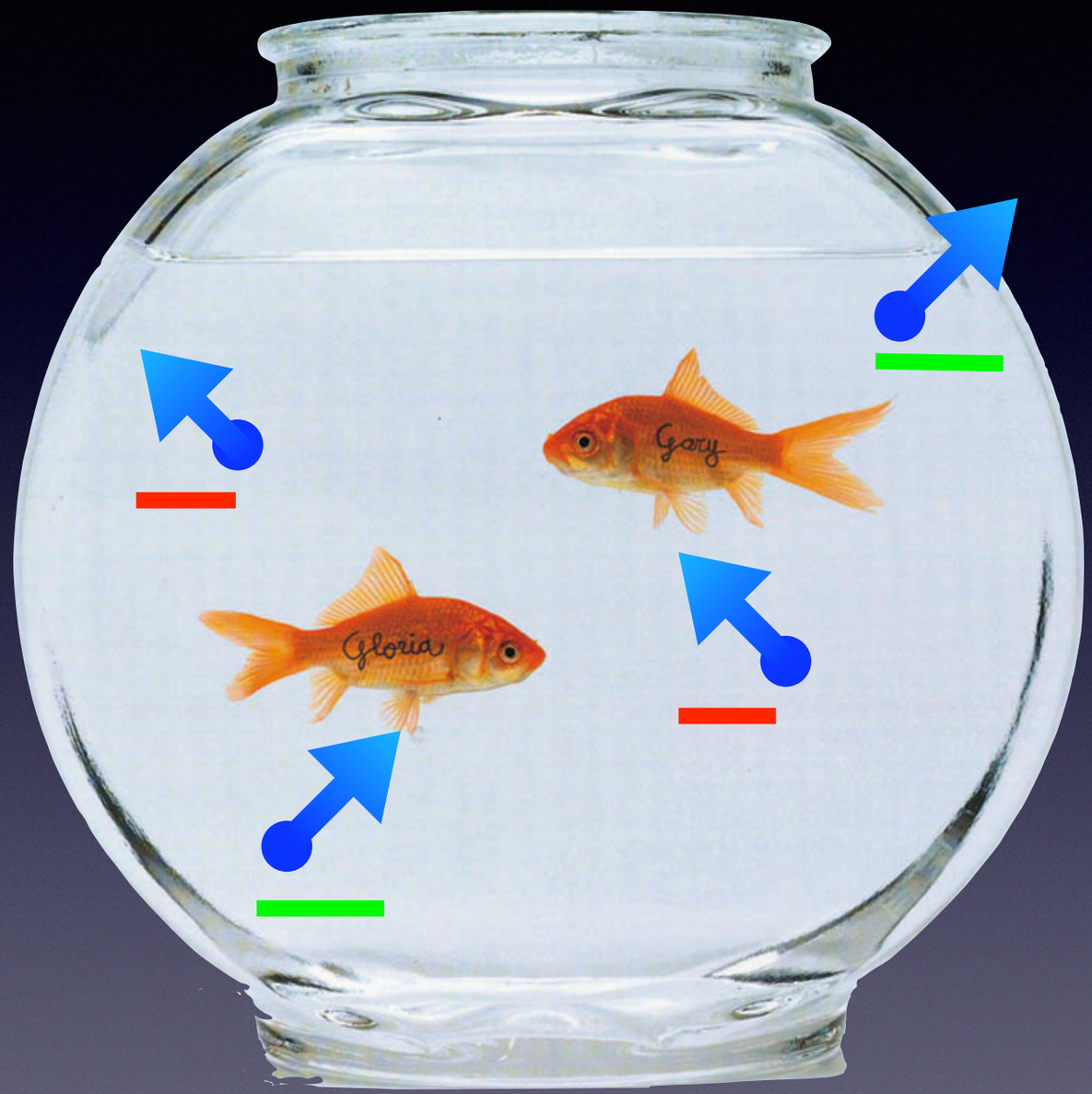
no gradient

Diffusion



opposite gradient

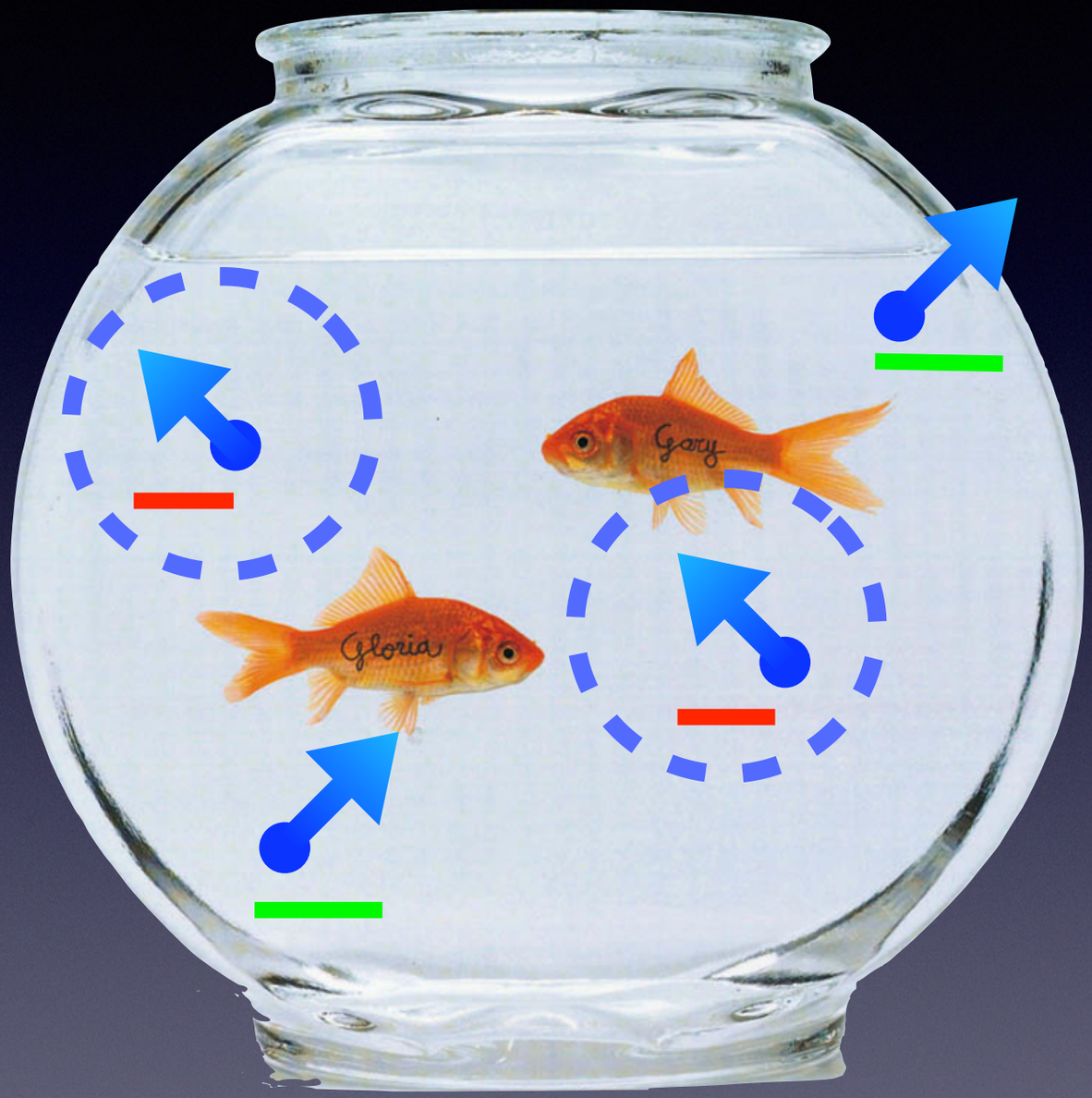
Diffusion



opposite gradient

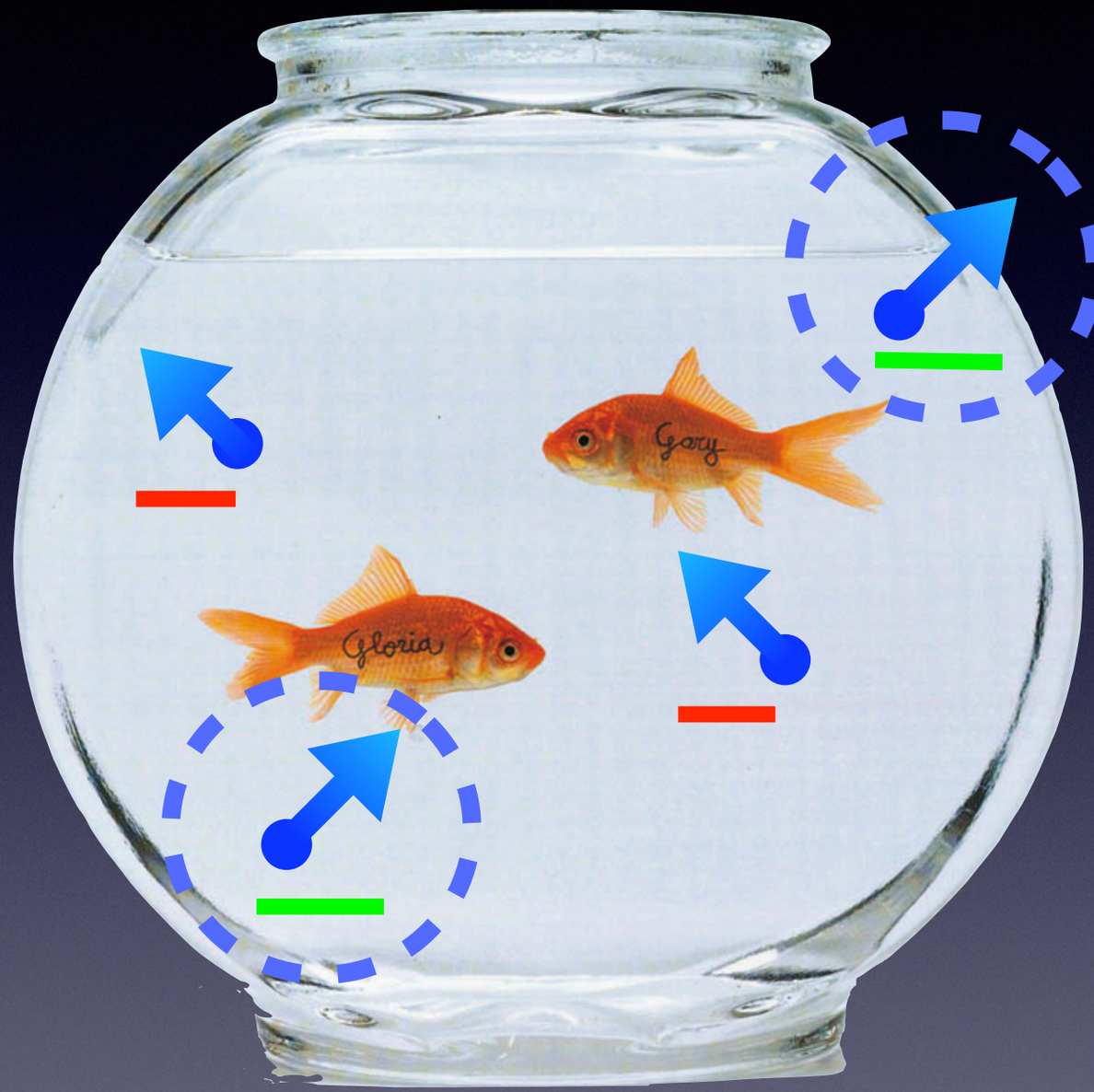
Diffusion

stationary =
re-focused



opposite
gradient

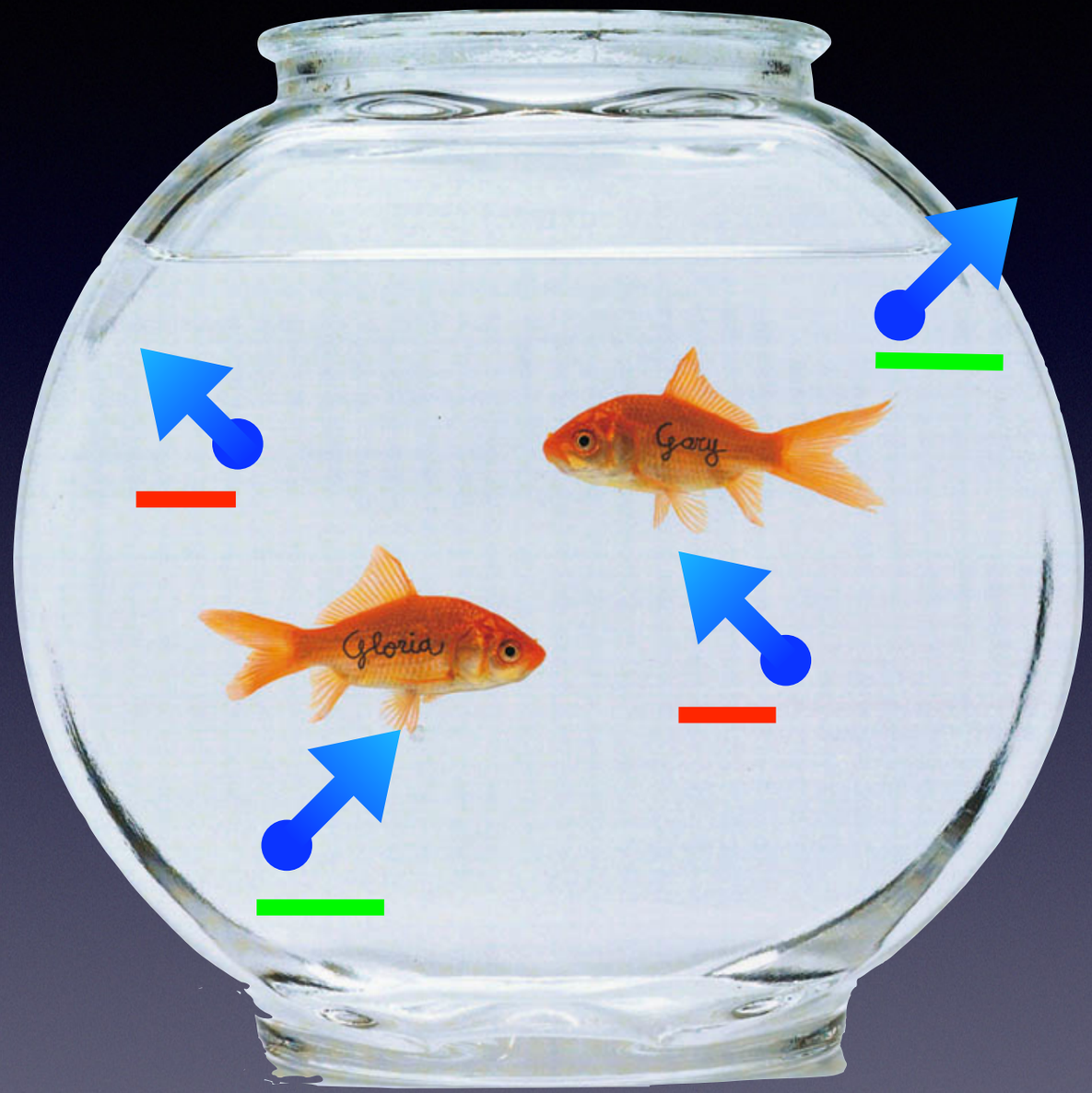
Diffusion



diffused = not re-focused

opposite gradient

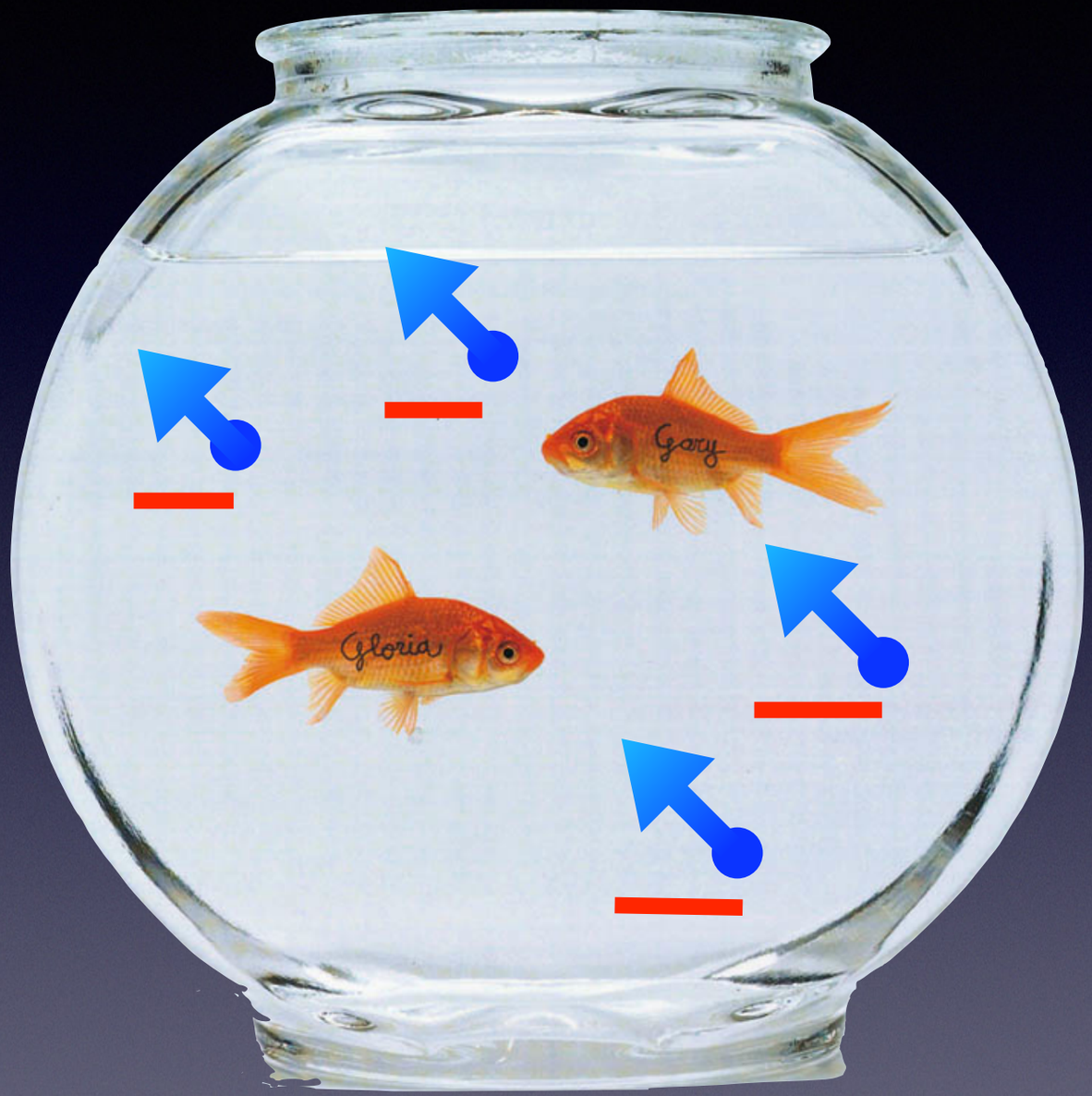
Diffusion



signal has cancelled out because of diffusion parallel to the gradients

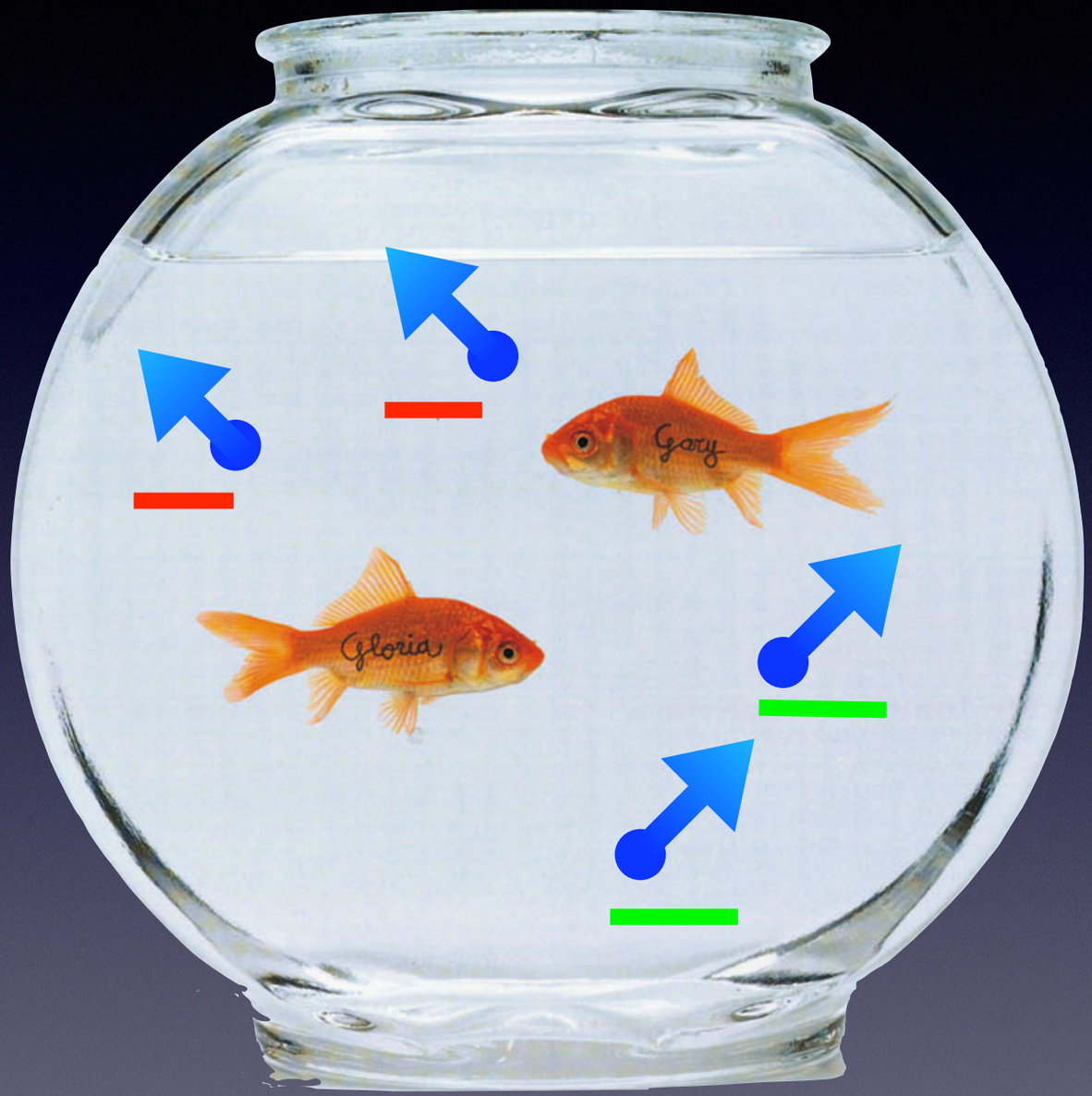
What happens with diffusion perpendicular to the gradients?

Diffusion



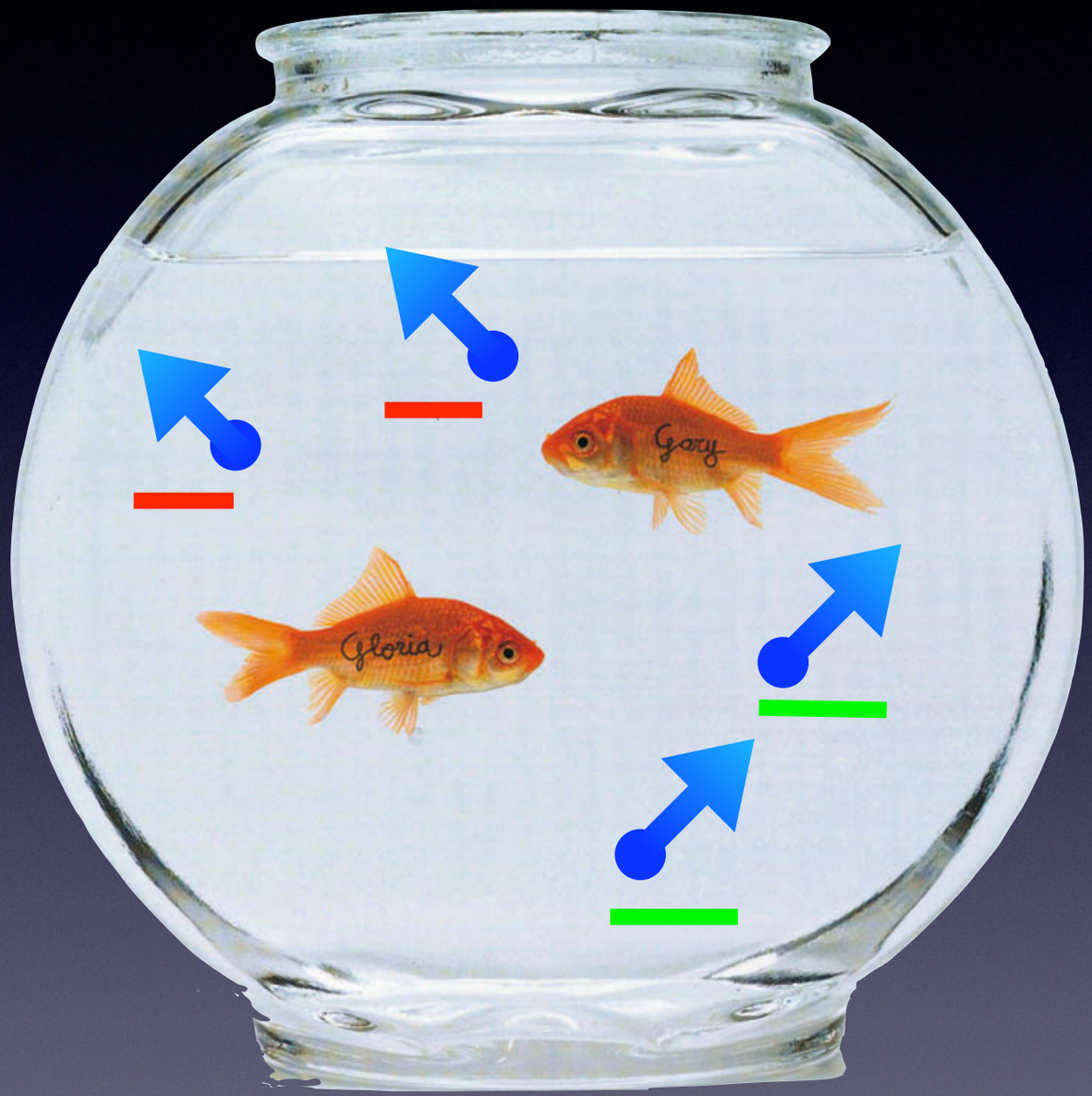
gradient

Diffusion



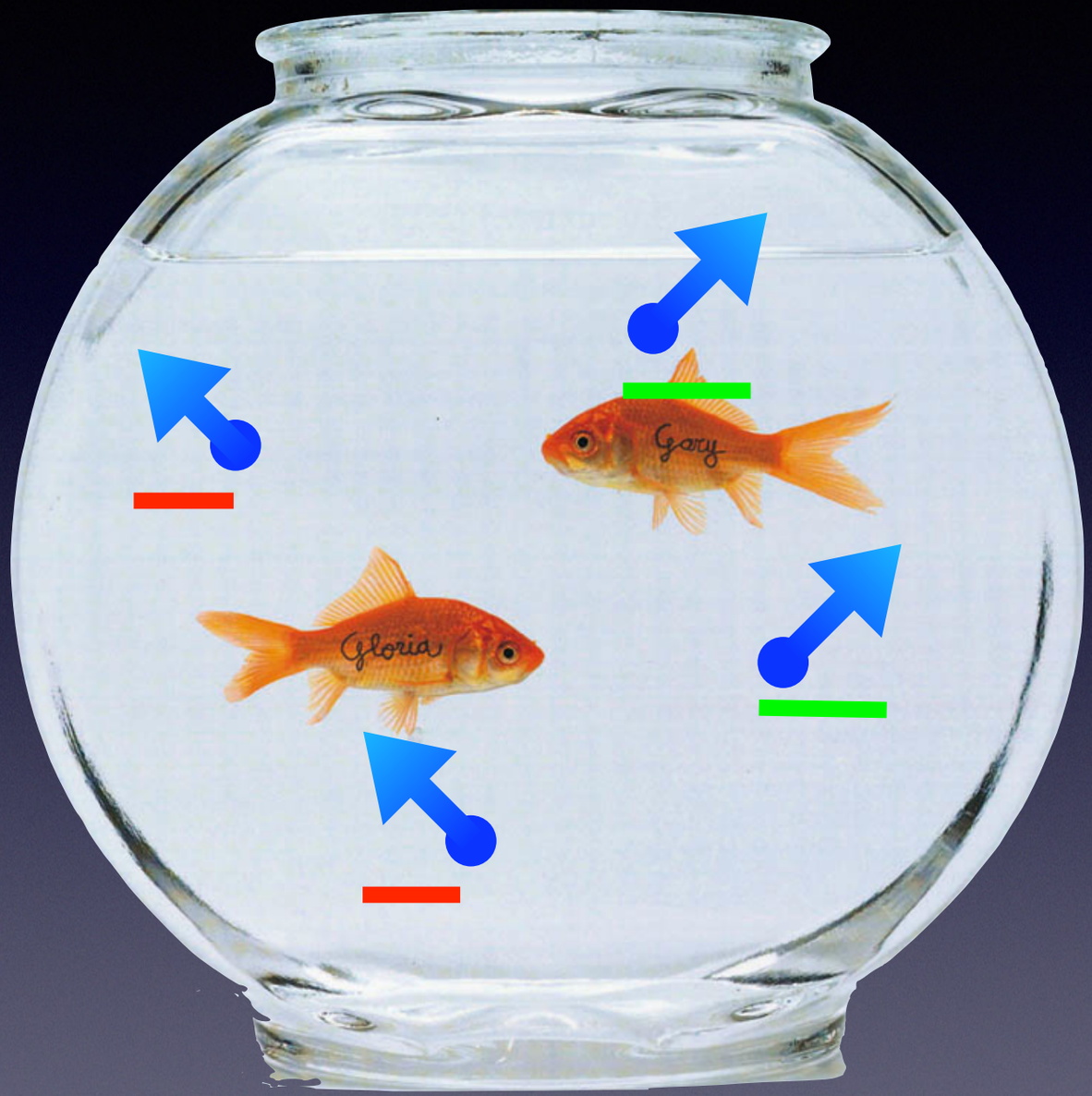
gradient

Diffusion



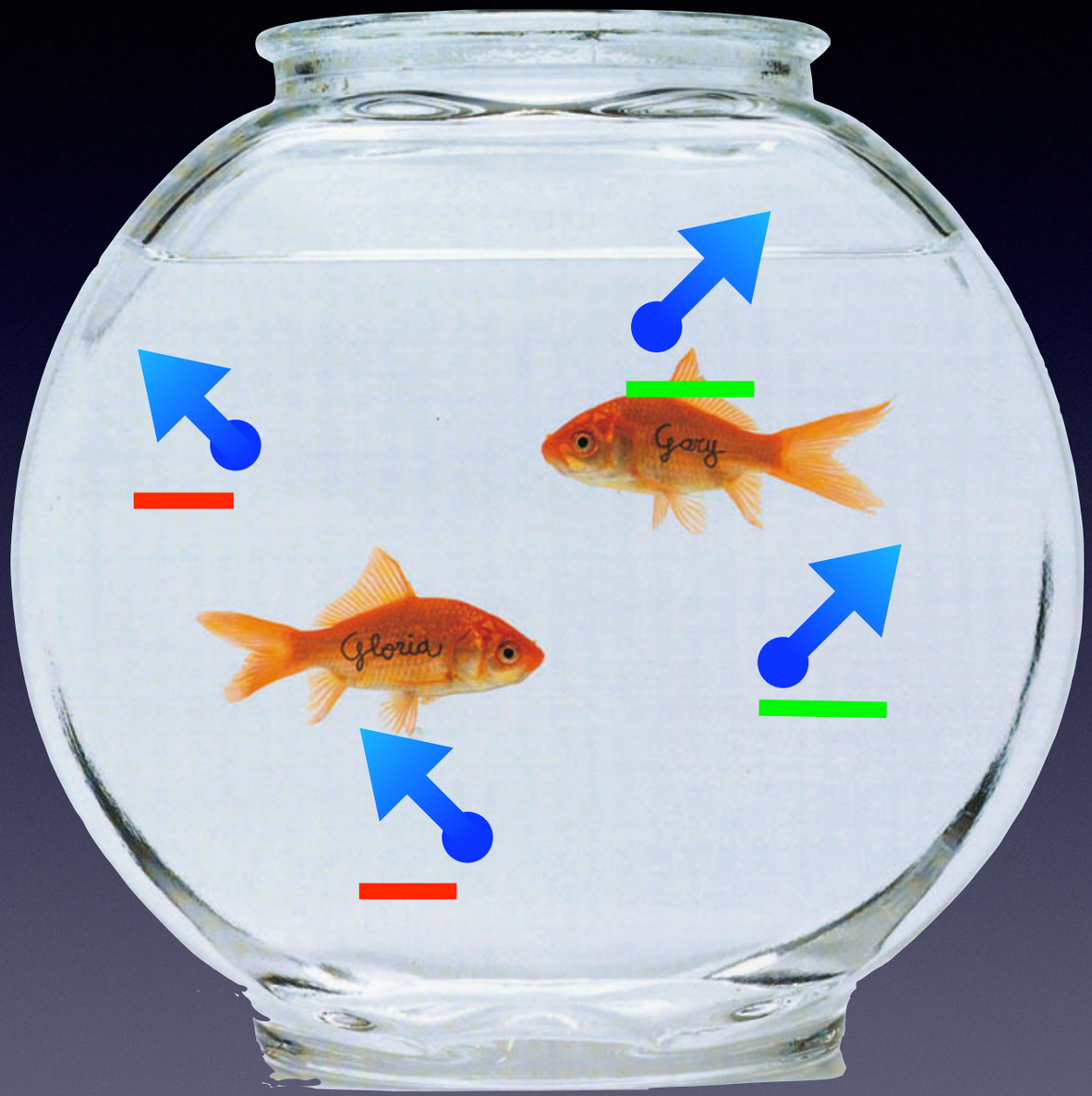
no gradient

Diffusion



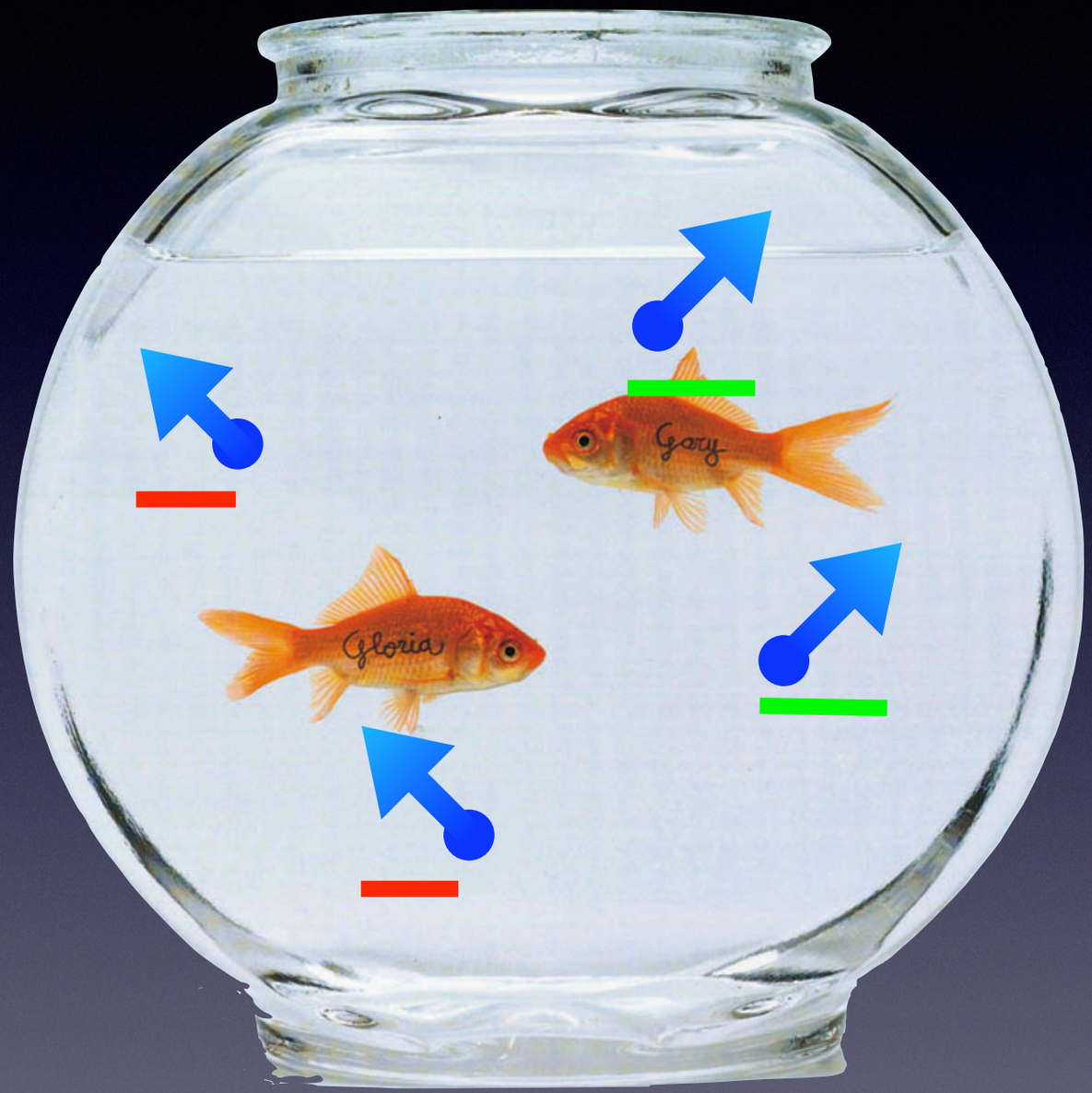
no gradient

Diffusion



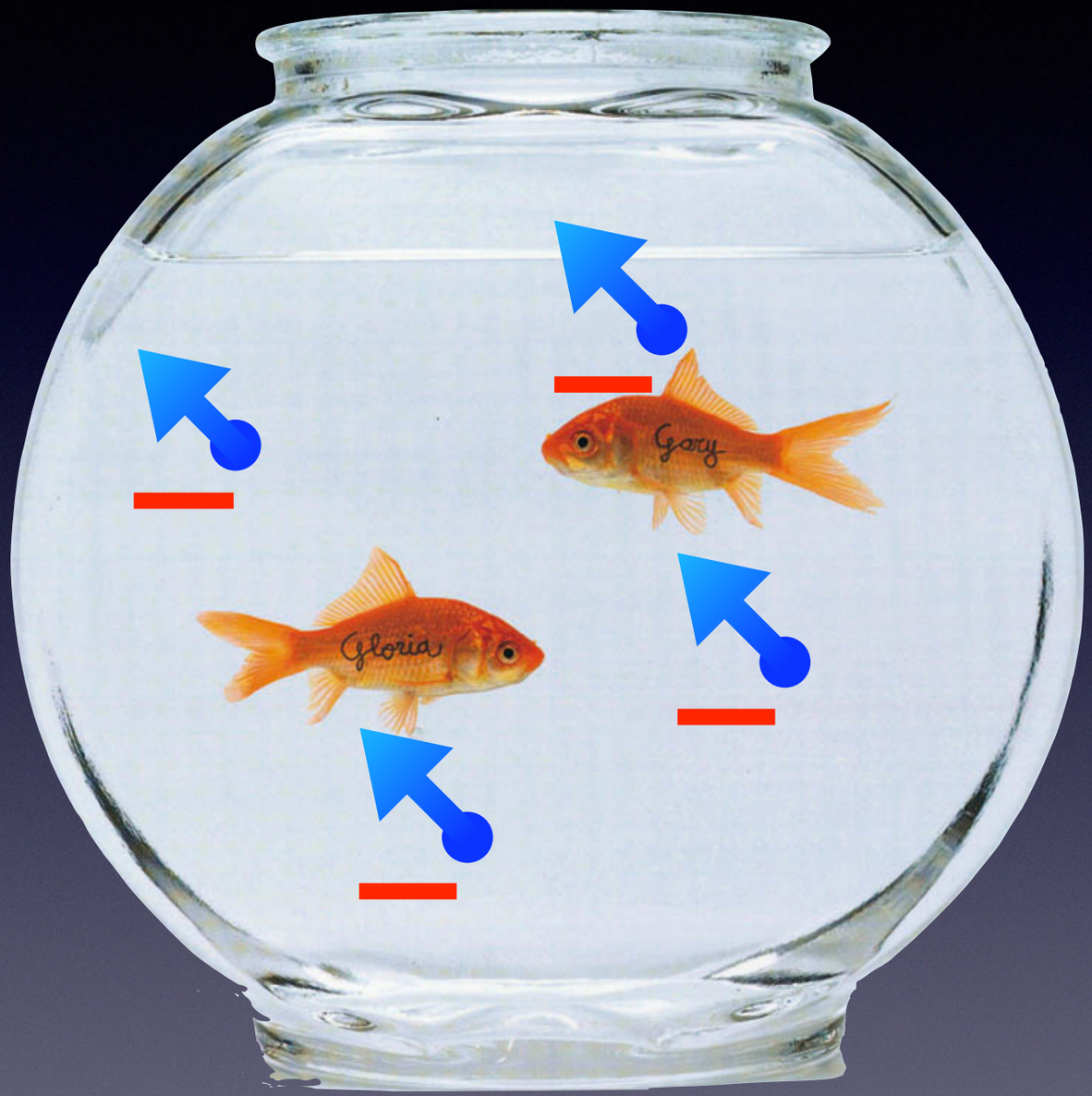
no gradient

Diffusion



opposite gradient

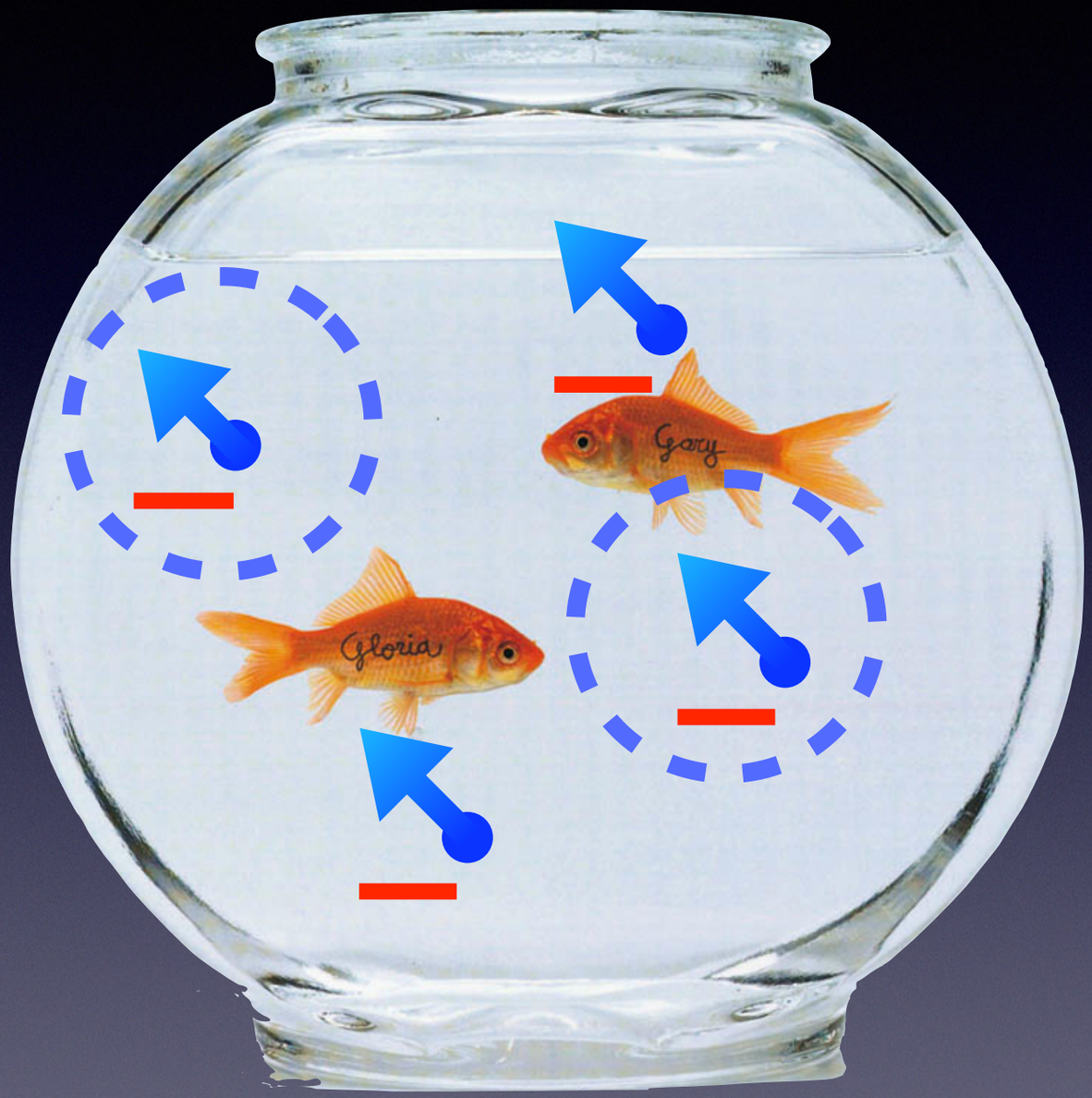
Diffusion



opposite gradient

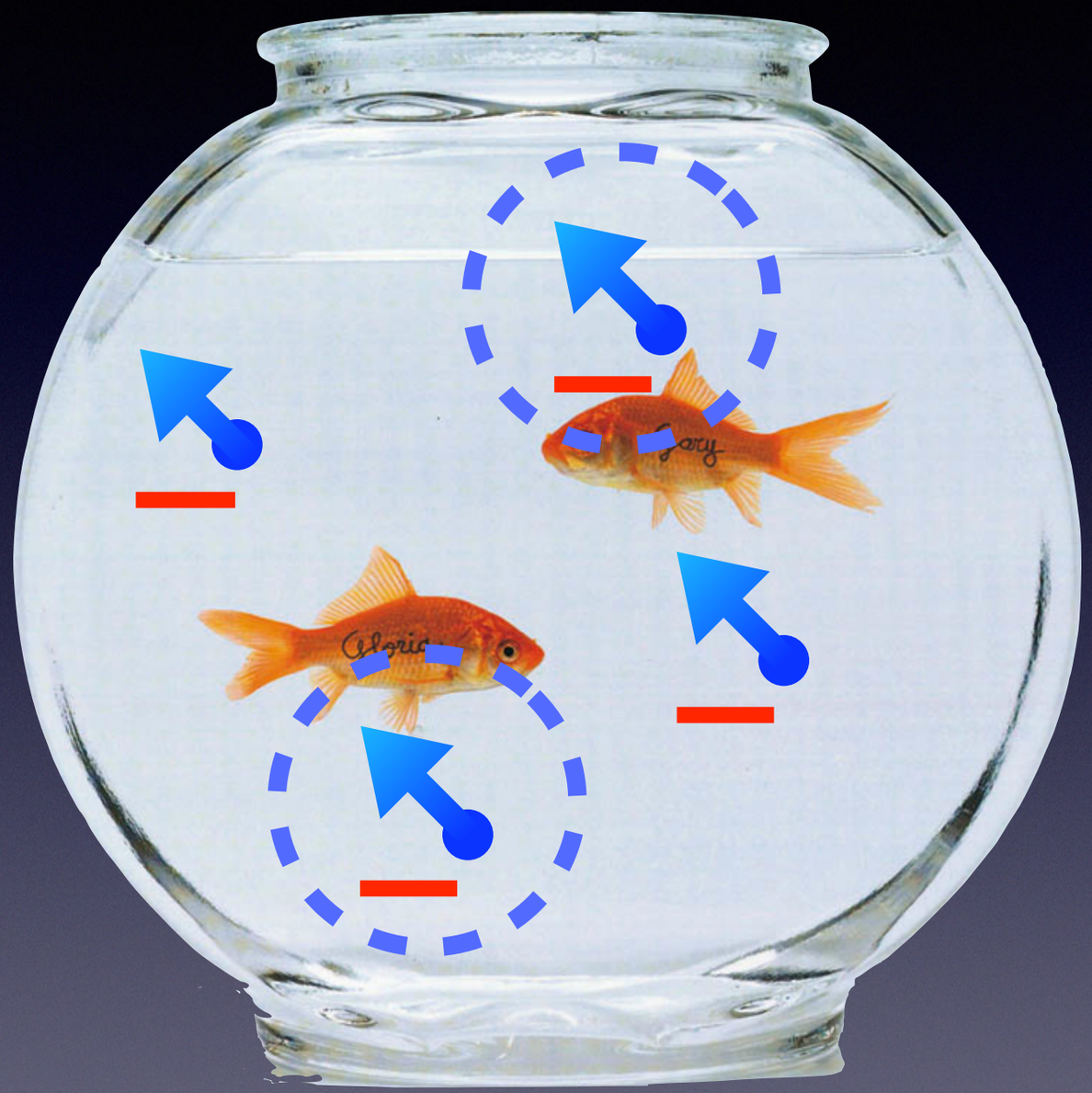
Diffusion

stationary =
re-focused



opposite
gradient

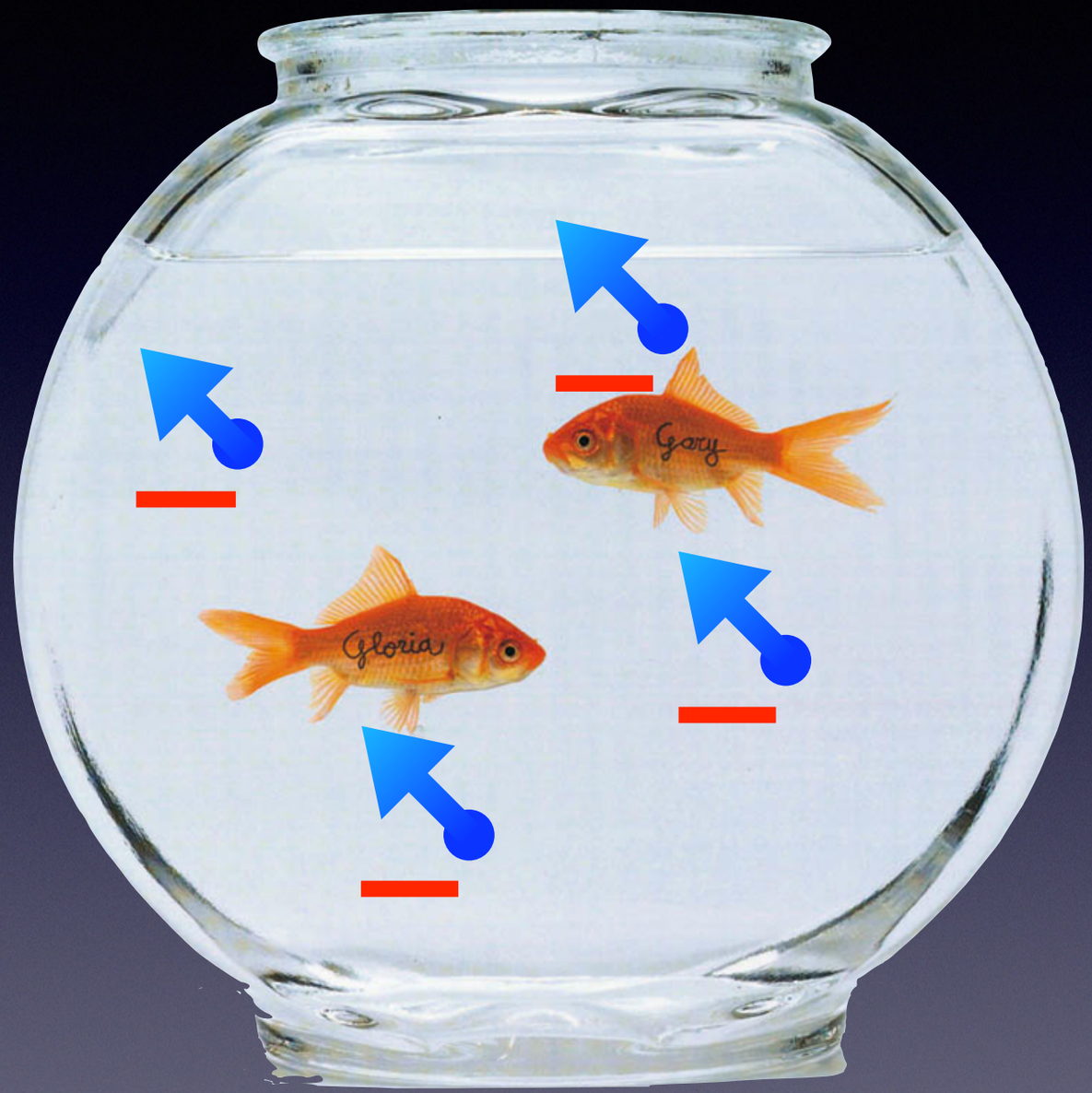
Diffusion



diffused =
re-focused

opposite
gradient

Diffusion



signal is unaffected by
diffusion perpendicular to the gradients

Diffusion imaging uses gradients to cancel out signal in water that moves in one direction.

Diffusion imaging uses gradients to cancel out signal in water that moves in one direction.

Repeating the experiment, each time using gradient in a different direction, creates a map of how freely water diffuses in each voxel.


Gary
Gloria

questions?