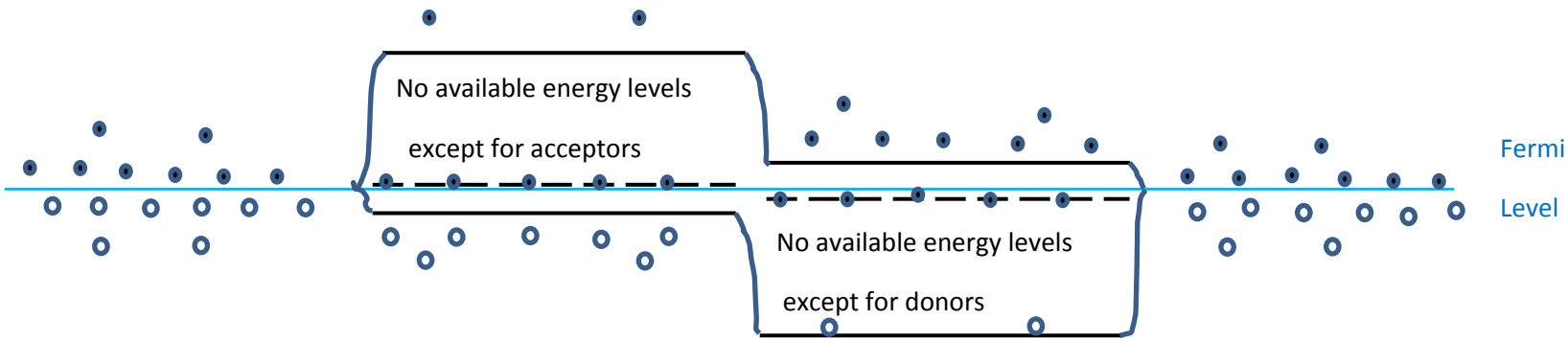
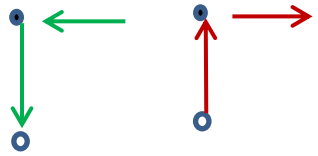
unbiased

metal	p-type	n type	metal
(conduction & valence band overlap)	(acceptor level near valence)	(donor level near conduction)	(conduction & valence band overlap)



● = electron in otherwise empty conduction band ○ = hole in otherwise filled valence band



Electrons excited by **thermal energy** to conduction band
electrons then can fall down going to the right

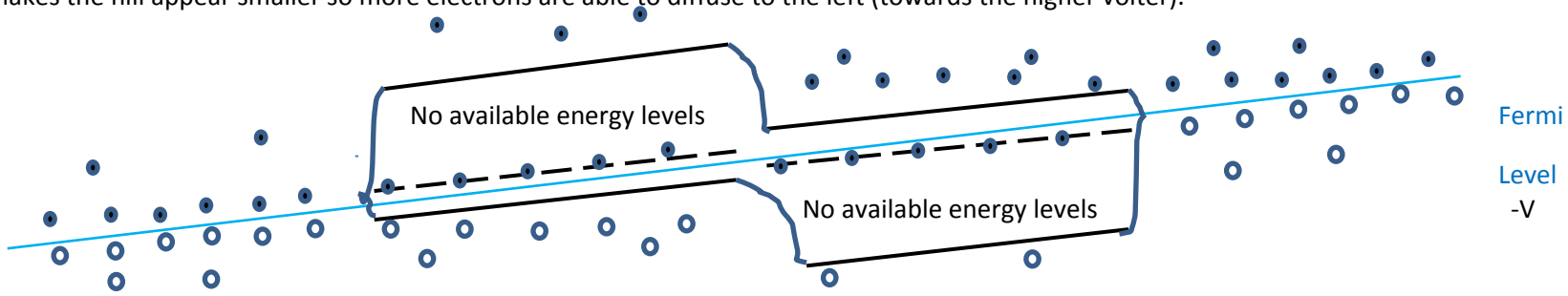
Electrons can **diffuse** to the left
electrons can then fall down and
recombine with a hole

In unbiased situation, thermal currents and diffusion (recombination) currents cancel for no net current.

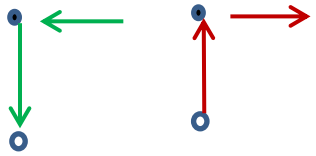
Forward biased

metal	p-type	n type	metal
(conduction & valence band overlap)	(acceptor level near valence)	(donor level near conduction)	(conduction & valence band overlap)

Electrons in conduction band can accept potential energy and move up in the conduction band because there are available energy levels; this makes the hill appear smaller so more electrons are able to diffuse to the left (towards the higher volter).



● = electron in otherwise empty conduction band ○ = hole in otherwise filled valence band



Electrons excited by **thermal energy** to conduction band
electrons then can fall down going to the right

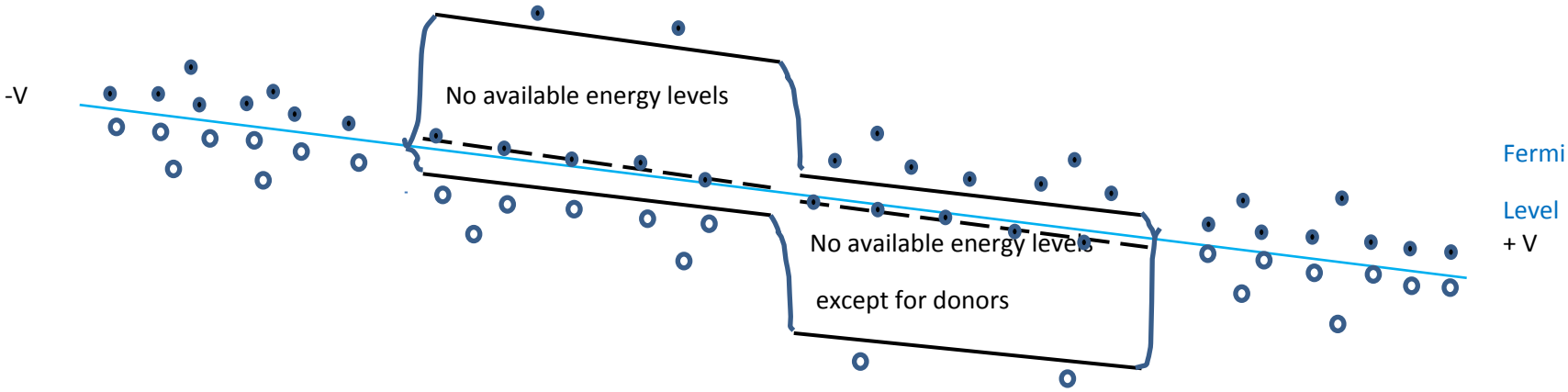
Electrons can **diffuse** to the left easier with forward bias
electrons can then fall down and **recombine** with a hole

+V lowers negative electron energy levels, -V raises them. Electrons tend to fall down in potential energy while holes tend to float up.

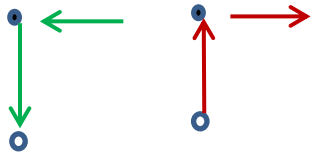
Thermal electron numbers are not changed, but recombination (diffusion) electrons go up exponentially since the "hill" is lower.

Reverse biased

metal	p-type	n type	metal
(conduction & valence band overlap)	(acceptor level near valence)	(donor level near conduction)	(conduction & valence band overlap)



= electron in otherwise empty conduction band = hole in otherwise filled valence band



Electrons excited by **thermal energy** to conduction band
electrons then can fall down going to the right

Electrons can **diffuse** to the left
electrons can then fall down and **recombine** with a hole

+V lowers negative electron energy levels, -V raises them. Electrons tend to fall down in potential energy while holes tend to float up.

Thermal electron numbers are not changed, but recombination (diffusion) electrons goes down exponentially since the “hill” is higher.