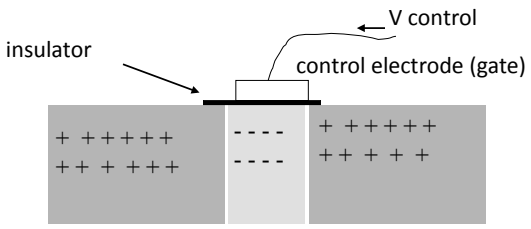
Transistors

- Can amplify an electrical signal

- Serve as switches

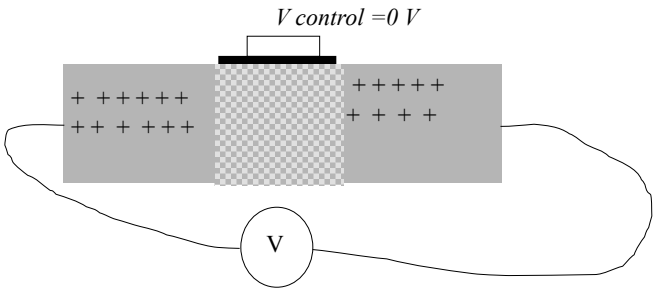


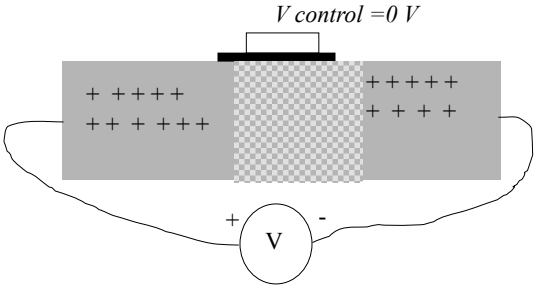
Transistors:

- NPN or PNP sandwiches-- double depletion region.

- Plus "gate" electrode to control depletion region (controls whether current can flow).

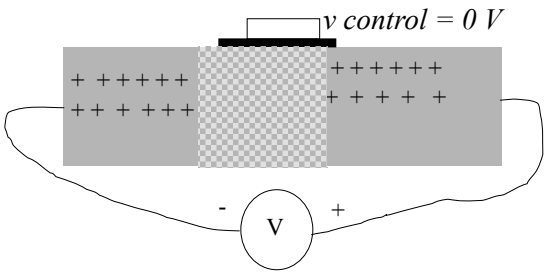
Field effect transistor:
- Free holes and electrons migrate.
- Big depletion region.





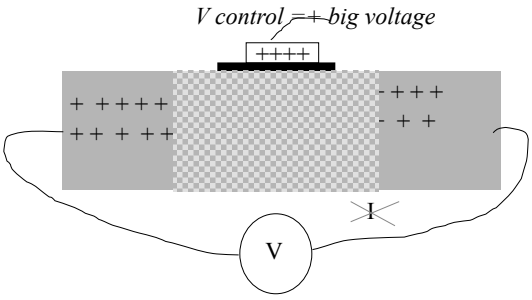
What happens if + voltage on left?

- Holes all move to the right
- Depletion region shifts over but it is still big
- NO current.



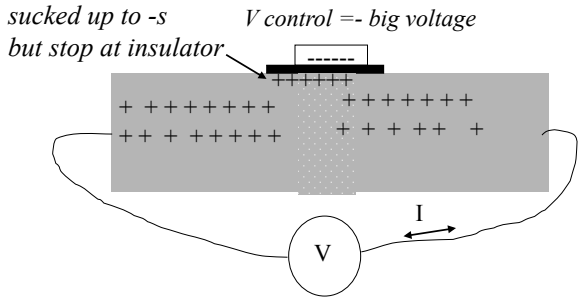
What if + voltage on right?

- Holes move to the left
- Still depletion
- NO current



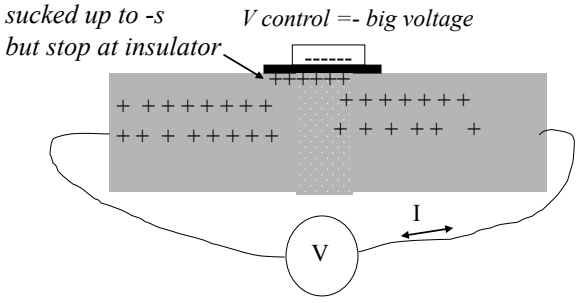
What happens if big positive control voltage on gate?

- Holes repel holes
- Depletion region gets bigger
- NO current



What happens if big negative control voltage on gate?

- Holes fill the depletion region
- Depletion region goes away
- Current flows easily in either direction.



Moderate negative voltage:

- reduce but not remove depletion,
- a few holes to carry charge, but less current (more resistance.)

The amount of current depends on the size of the negative control voltage:

$V_{gate} \geq 0$, no current (like open switch).
V_{gate} large and negative, like closed switch (no resistance).
V_{gate} negative, current varies as negative voltage varies but gives amplification.

How do we get amplification?

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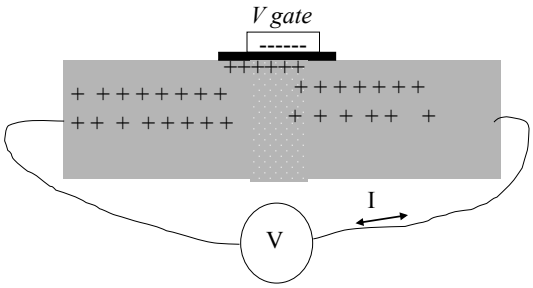
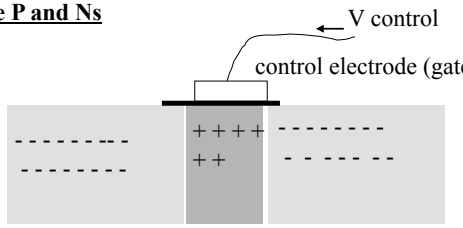


- Vary gate voltage (such as from reading music)
- Small variation in gate voltage results in large variation in current through transistor
- Measure voltage through transistor → voltage amplifier

Reverse the P and Ns



N-P-N doped semicond.
"N type" transistor(?!)

Everything the same with charges and voltages reversed.