

There are a few **roles** to be played. They are as follows:

Battery

Two people make up the battery; but they will only interact with semiconductor material, not with each other. Semiconductors must obey you.

Positive Terminal - Electrons flow toward you and holes flow away from you

Negative Terminal - Electrons flow away from you and holes flow toward you.

N-Type Semiconductor

You have two possible states or 'alignments':

Neutral

- If you have an electron, you're electrically neutral.
- You'll gladly give up your electron because it's loosely bound. In particular, if you're adjacent to **P-Type Semiconductor** atom, you may give your electron to him/her.
- If you give up your electron you become a **Positive Ion** (below)

Positive Ion

- You have no electron, but you have a full valence shell --- you're "happy."
 - You do not receive holes.
 - If you are adjacent to a **Negative Ion** (below), electrons will only flow between you in the presence of a battery which overcomes your *barrier voltage* of 0.7V.
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P-Type Semiconductor

You have two possible states or 'alignments':

Neutral

- If you have a hole, you're electrically neutral
- You desire an electron to fill your valence shell.
- If you're adjacent to an **N-Type Semiconductor** atom, ask him/her (nicely) for an electron.
- If you accept an electron, you become a **Negative Ion** (below)
 - The electron and hole will "annihilate" each other; stick 'em in the bins provided.

Negative Ion

- You have no hole, but you have a full valence shell --- you're "happy."
 - You repel electrons! The potential difference between you and an adjacent **Positive Ion** (above) is approximately 0.7V. This voltage must be overcome by the action of a **Battery** (above) in order to "force" you to receive (and pass along) electrons.
 - You do not want to give up any of your electrons.
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Games to Play:

- "Forward Bias": **Positive Terminal** connected to **P-Type Semiconductor**, **Negative Terminal** connected to **N-Type Semiconductor**.
- "Reverse Bias": **Negative Terminal** connected to **P-Type Semiconductor**, **Positive Terminal** connected to **N-Type Semiconductor**.