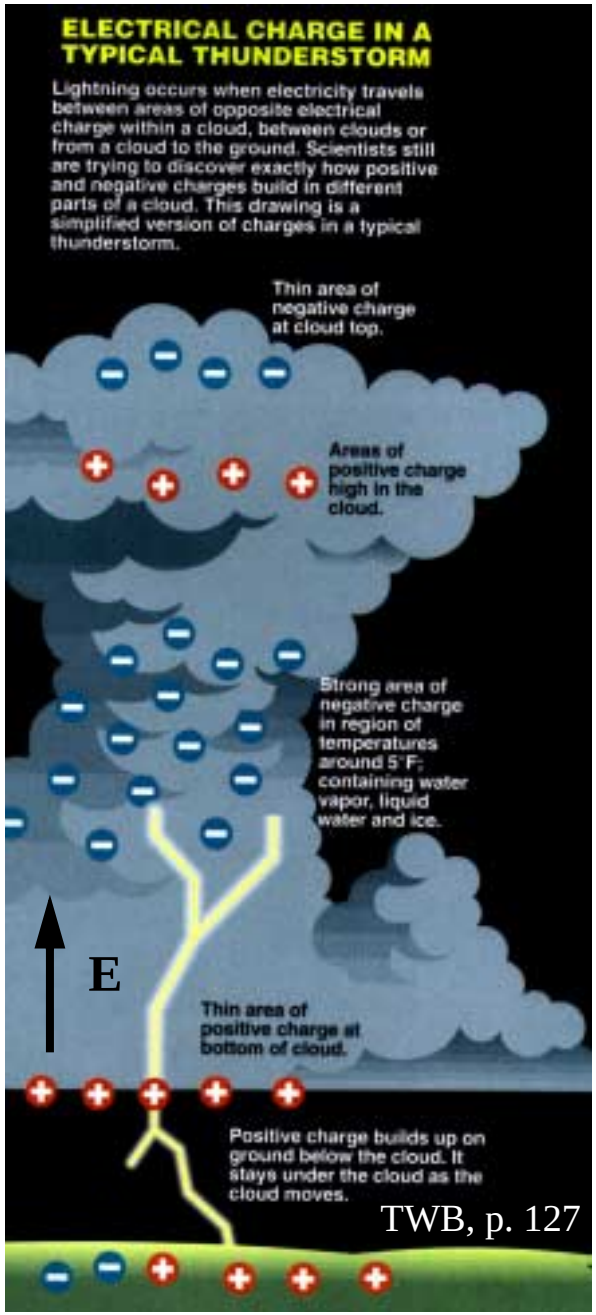
Lecture 27 Cloud Electrification

- Lightning forms because different charges build up in parts of cloud.
- Supercooled water and small ice particles rising in the updraft transfer electrons (negative charge) when they collide with larger ice particles, positively charging the top of the cloud and leaving negative charge in the middle of the cloud.
- If electric field **E** exceeds 1 million volts per meter, electrons are torn off air molecules, *ionizing* the air. Charge can now flow freely.



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Facts about Lightning

- Cloud-to-cloud (80%) or cloud to ground (20%)
- A short channel of air in the cloud ionizes.
- Electrons migrate downward, attracted by the positive charge below.
- One or more channels roughly 50 m long ionizes underneath, continuing the downward march of electrons in the *stepped leader.*
- As stepped leader nears ground, one or more *streamers* of positive charge also ionize a channel.
- When a streamer meets the leader, a powerful wave of current moves up the ionized channel at 1/3 the speed of light...a lightning stroke.
- Several strokes usually occur in quick succession to make a lightning flash.
- The glow of the ionized air, heated up to 30,000 C, makes lightning visible. The rapid thermal expansion and contraction of air create sound waves, which spread 1 mile every 5 secs to make thunder.
- Lightning starts 10,000 fires a year over the US. Most drier western forest ecosystems need occasional lightning-set forest fires to remain healthy.

Film: Lightning - Electric Skies (35 min)