**THE SCIENCE OF THUNDERSTORMS**

**LIGHTNING**
Air updrafts in storm clouds carry small water droplets and ice crystals up, while denser soft hail falls. When they collide, ice crystals become positively charged and soft hail becomes negatively charged. Consequently, the cloud’s top becomes positively charged, with its base becoming negatively charged.

- **POSITIVE CHARGE**
- **NEGATIVE CHARGE**
- **SOFT HAIL (GRAUPEL) FALLS**
- **CLOUD TO GROUND LIGHTNING**

The cloud’s negatively charged base repels electrons on the ground. Cloud-to-ground lightning is one type of lightning – others also result from the charge difference in clouds.

**LIGHTNING CHEMISTRY**
Lightning strikes can split diatomic oxygen in the air into individual oxygen atoms. These combine with other oxygen molecules to form ozone, giving rise to the ‘pre-rain’ smell.

- Electrical discharge splits oxygen molecules
- Oxygen + oxygen → ozone
- Lightning ionises air molecules in its path. The blue-violet colour of lightning is a consequence of light emissions from excited nitrogen and hydrogen atoms.

**THUNDER**
Lightning causes rapid heating and expansion of nearby air, followed by cooling and contraction. This creates a sonic shock wave – thunder.

- **LIGHTNING TEMPERATURE**
  - 30,000 °C
  - (temperature of air channel through which lightning passes)

- **THUNDER SPEED**
  - ~ 343 m/s
  - (travels approximately 1 km in 3 s)

At the high temperatures lightning generates, nitrogen and oxygen combine to form nitrogen oxides. These dissolve in rain and form nitrates, important for plant growth.

- Nitrogen + Oxygen = Nitrogen Oxides
- Nitrogen Oxides + Rain = Nitrates

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