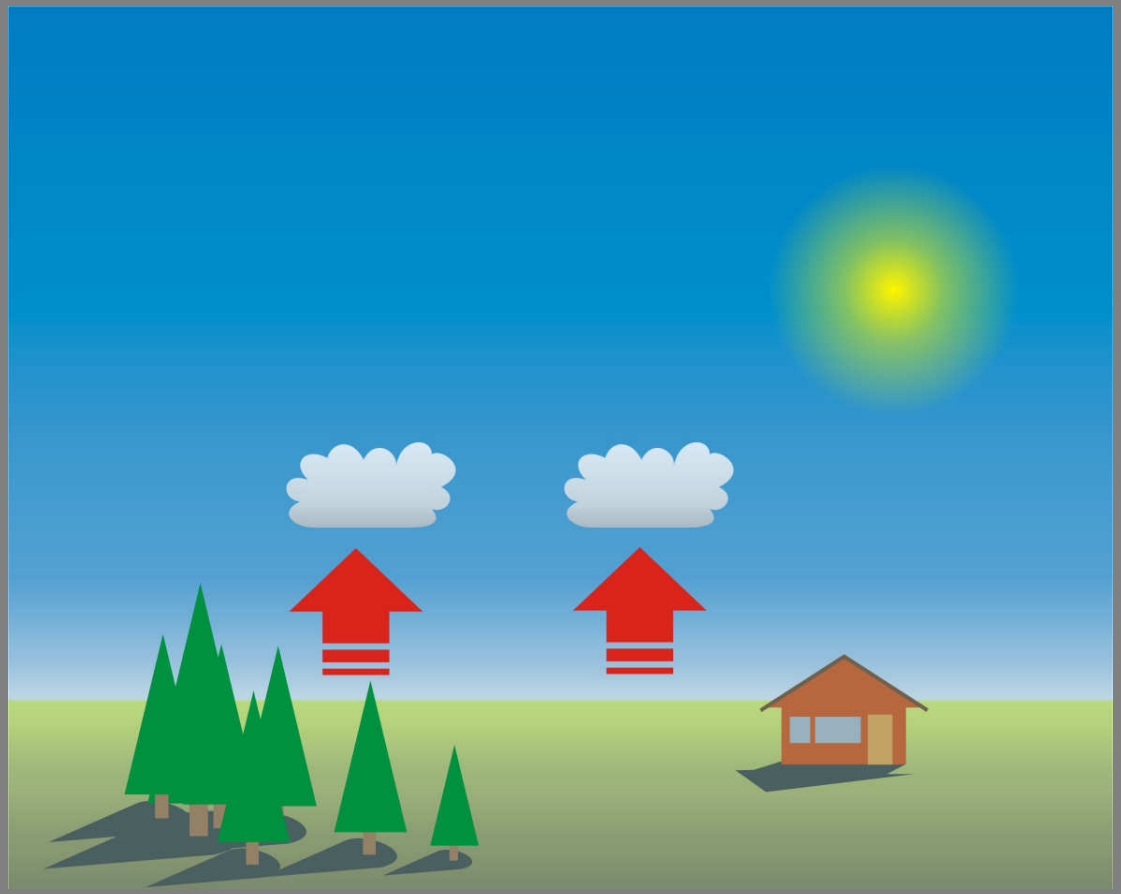
# LIGHTNING SAFETY and DETECTION SYSTEM

# THUNDERSTORMS, LIGHTNING And DETECTION

# *Introduction*

- Development of Thunderstorms
- Characteristics of Thunderstorms
- Lightning Facts
- Chances of Being Affected by Lightning
- Lightning Incidents
- Lightning Hazards
- Being Struck by Lightning
- Lightning Safety

# Development of Thunderstorms



- During a warm and sunny day the sun heats the ground and warm air rises.
- At a certain level small clouds start to form.

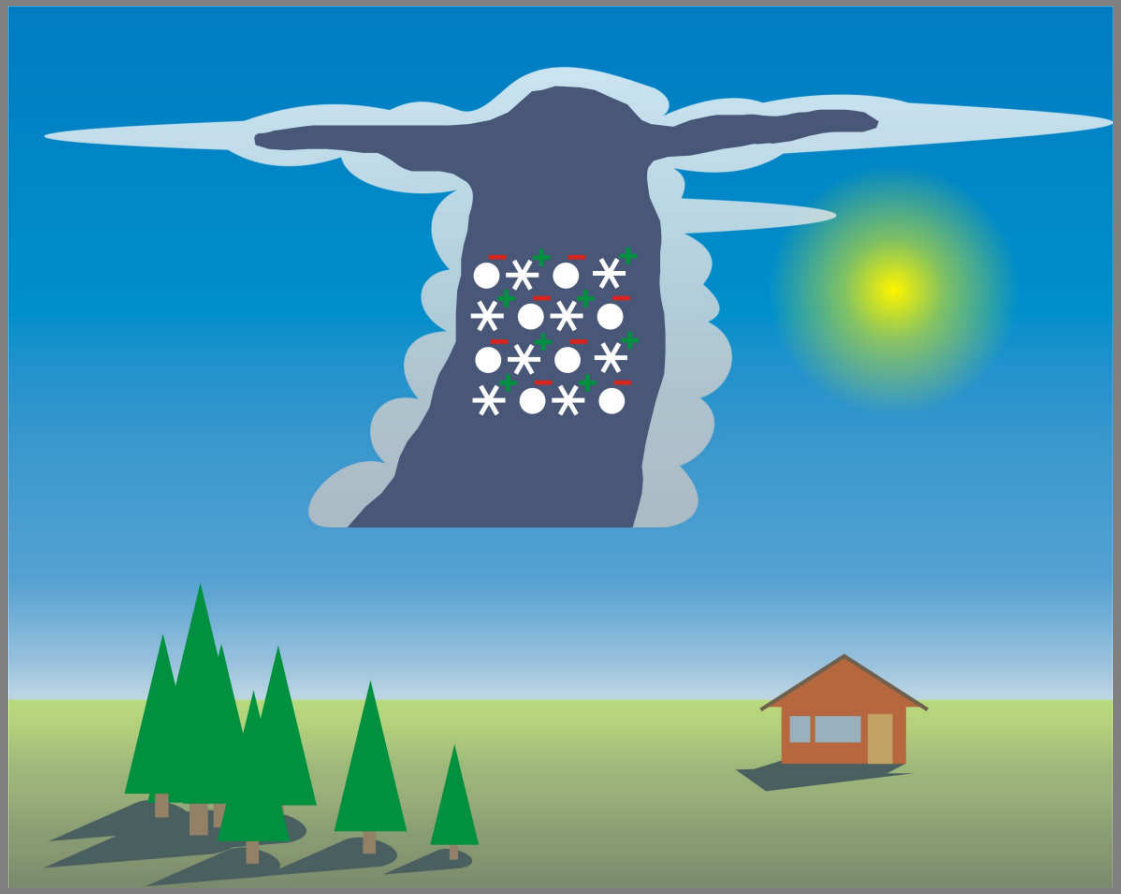
# Development of Thunderstorms

- When heating continues, clouds start to develop vertically.
- This is the first sign of a possible thunderstorm.

# *Development of Thunderstorms*

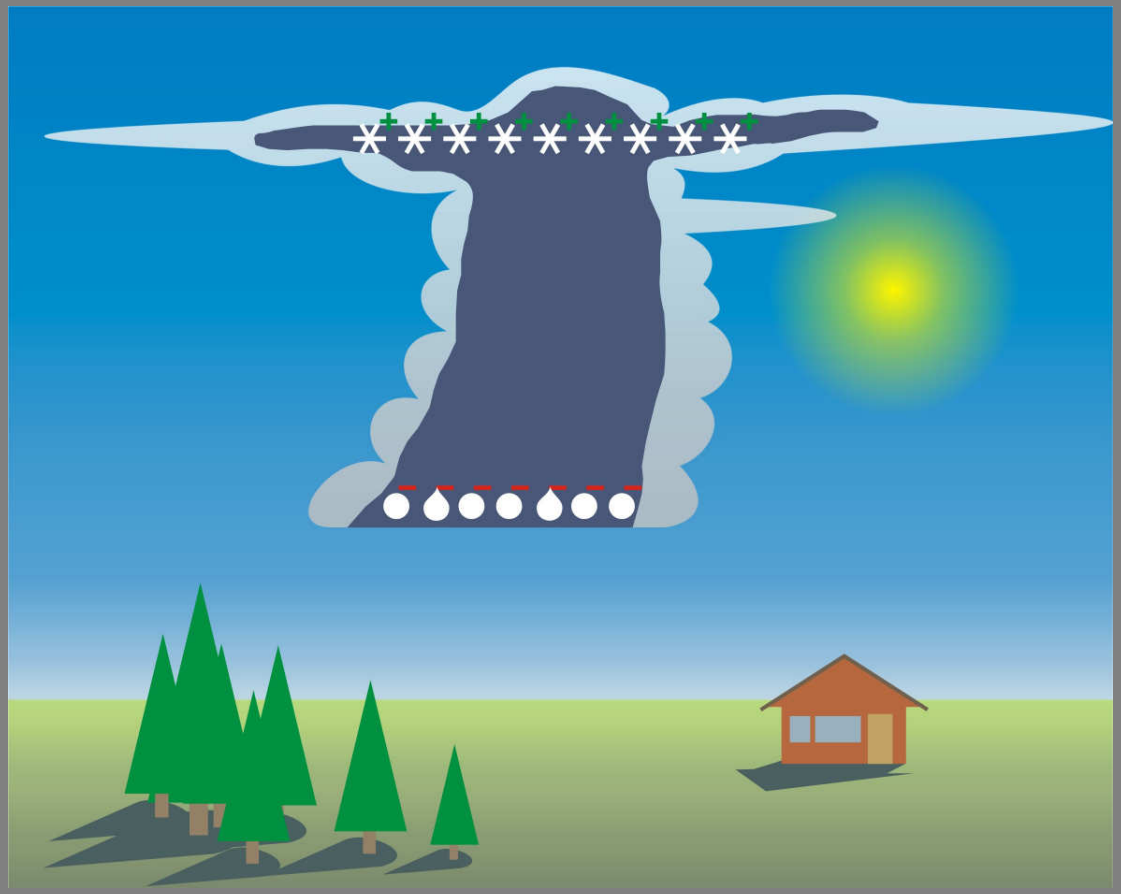
- Eventually, as the thunderstorm matures, an ‘anvil’ forms near the top of the storm.

# *Development of Thunderstorms*



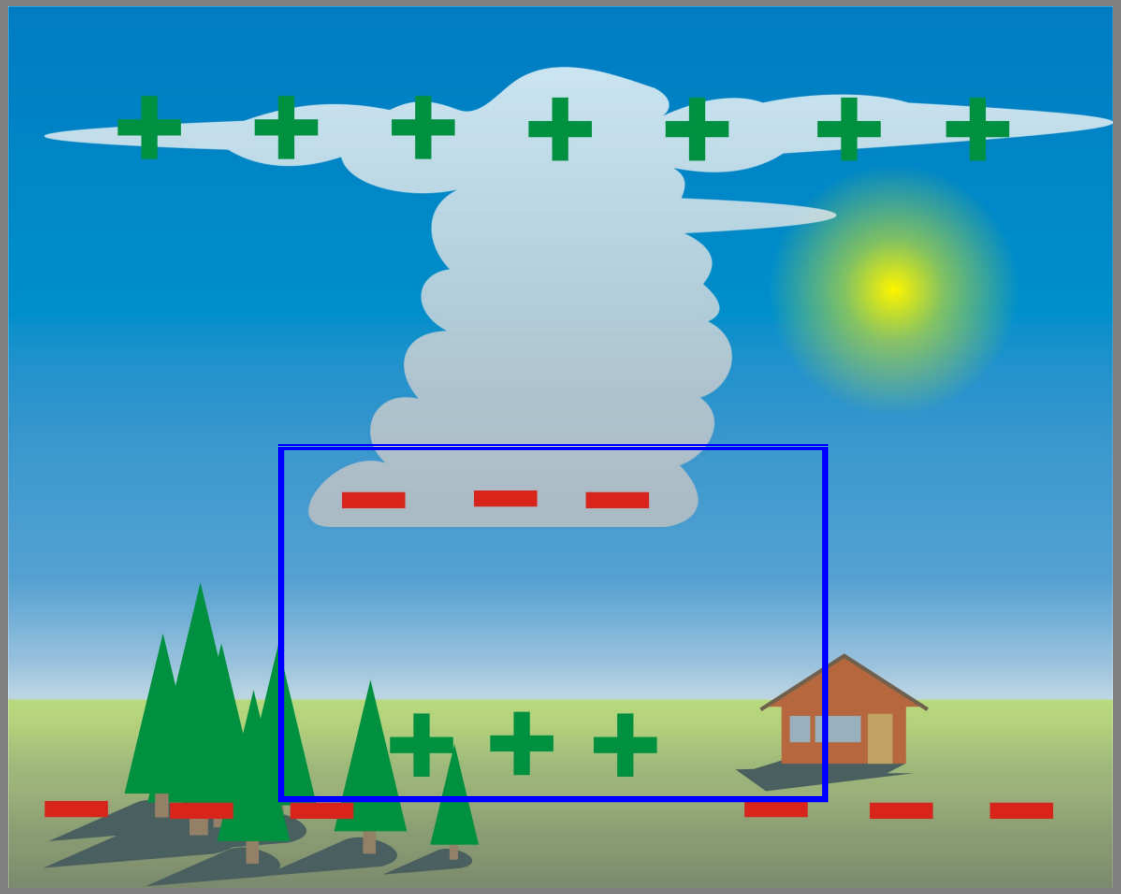
- Rising air causes precipitation to form throughout the inside of the cloud.
- Near the centre of the cloud this precipitation is a mix of ice crystals (snow) and ice pellets.
- Due to collisions between the ice crystals and ice pellets, ice crystals become positively charged and ice pellets become negatively charged.

# Development of Thunderstorms



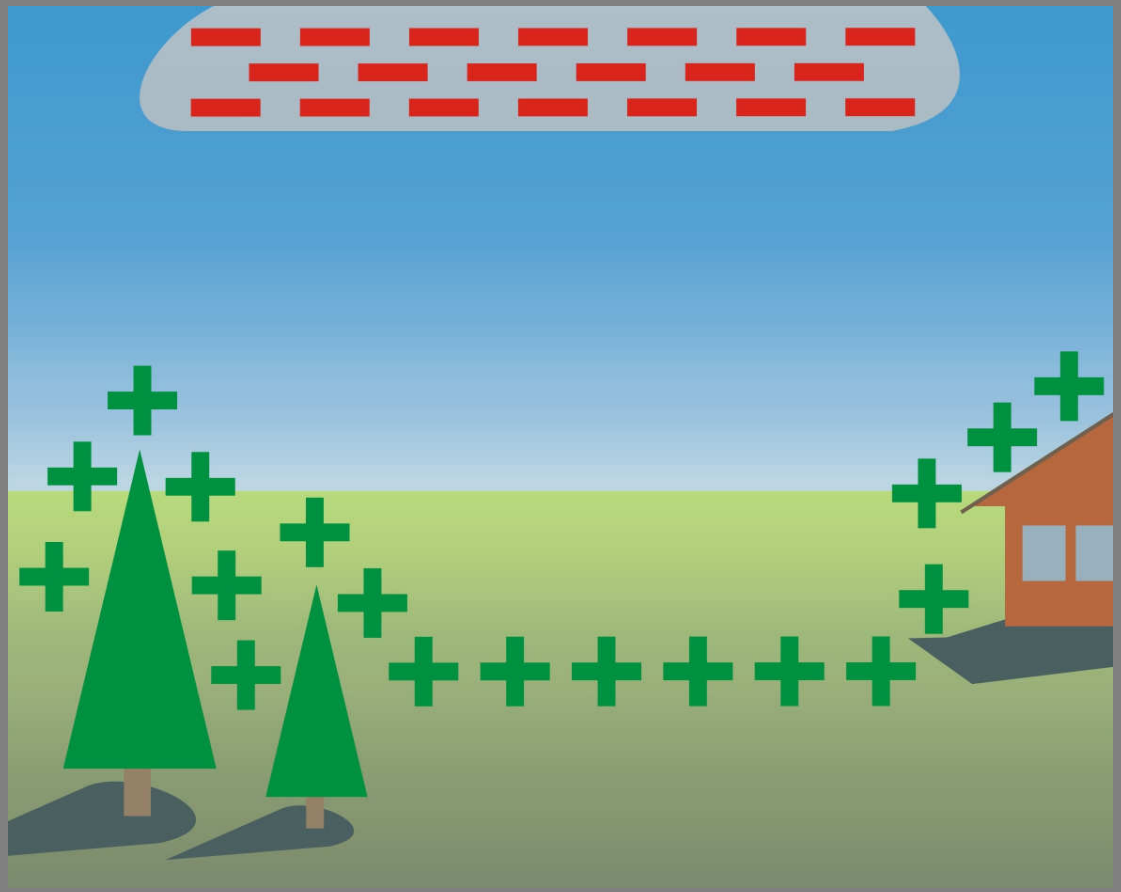
- Ice crystals are lighter than ice pellets and are carried upward towards the top of the cloud.
- Ice pellets are relatively heavy and fall towards the base of the cloud.
- Some ice pellets start to melt and turn into rain.

# Development of Thunderstorms



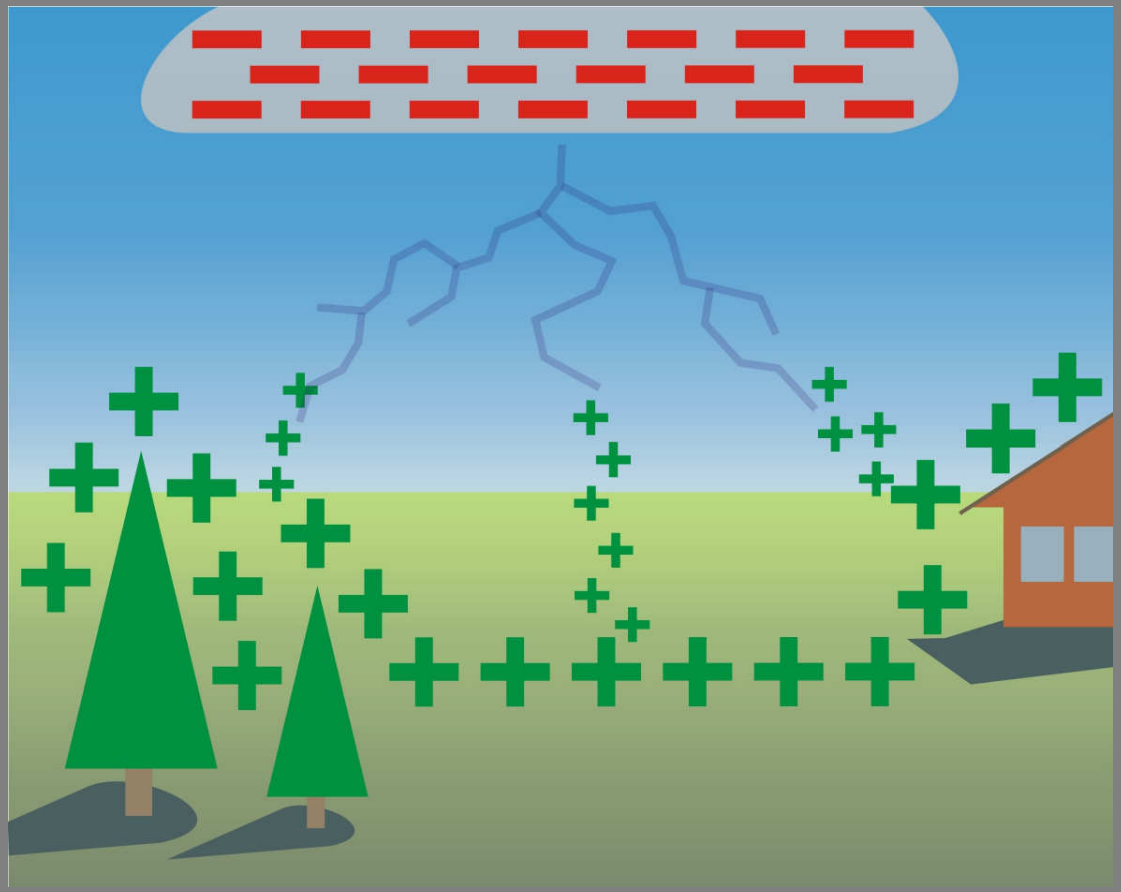
- Due to the separation of ice crystals and ice pellets, the top of the cloud becomes positively charged. The base of the cloud becomes negatively charged.
- The electrical field of the cloud induces the opposite field on the ground.
- The ground directly below the base of the cloud becomes positively charged and the ground below the ‘anvil’ becomes negatively charged.

# *Development of Thunderstorms*



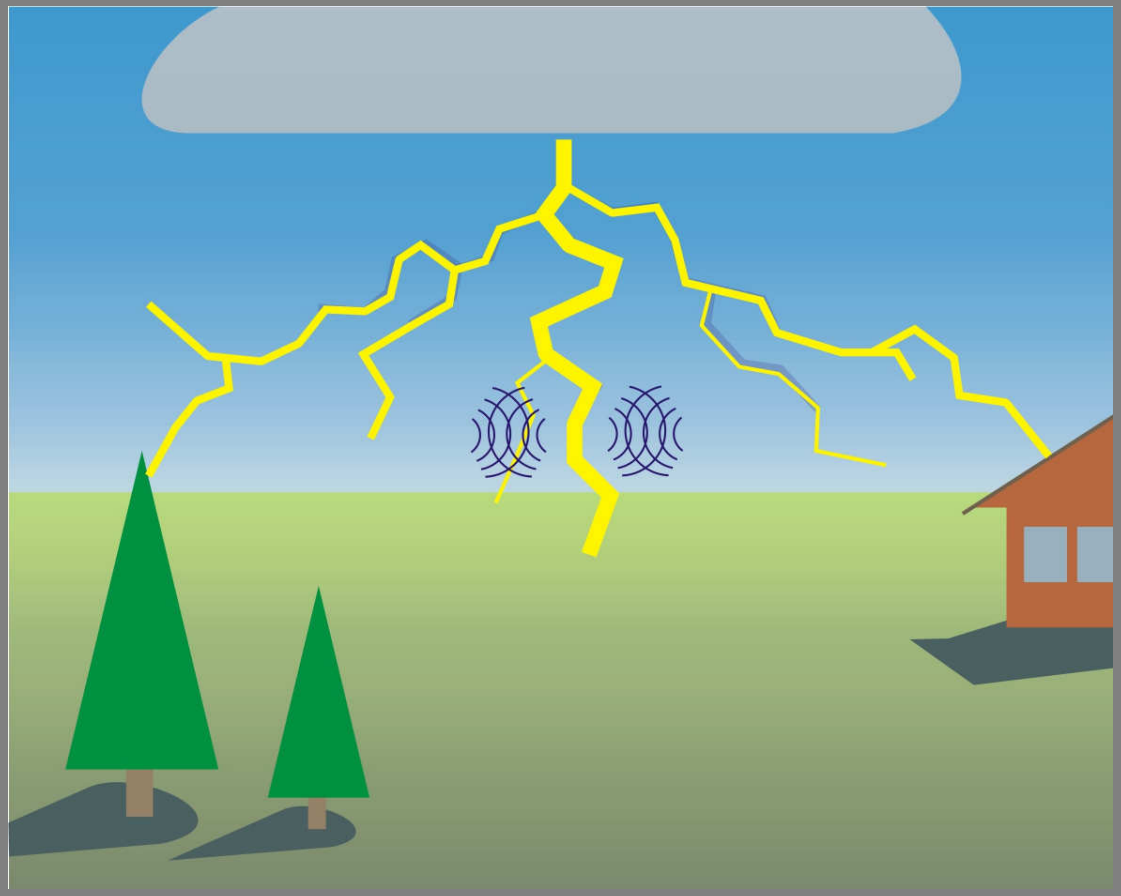
- Directly under the base of the cloud, positive charges start to build up.
- Not only do positive charges build up on the ground, they also build up on e.g. buildings, machinery, trees and people.

# *Development of Thunderstorms*



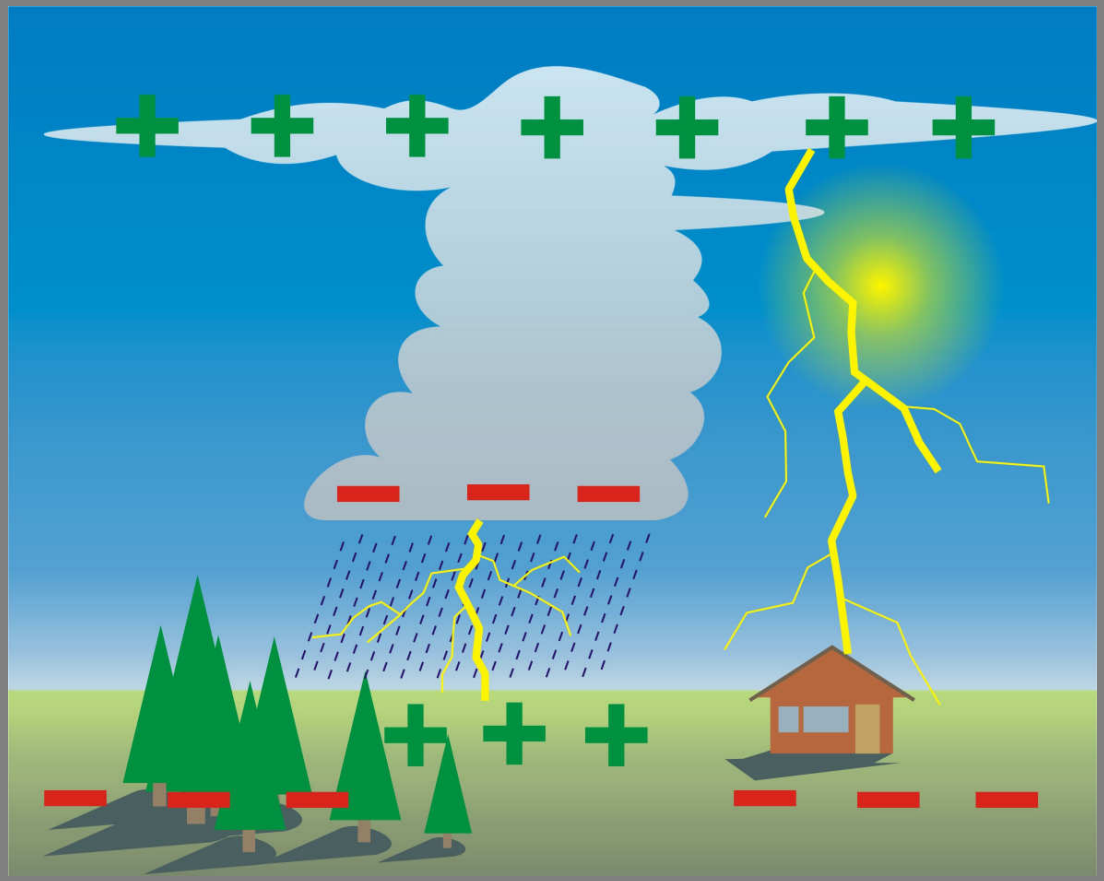
- When the difference between the negative and positive charges becomes too great, an invisible negatively charged channel of air develops in the lower part of the cloud and surges in steps of ~50m downward. This is called the ‘step leader’.
- At the same time, positive charges stream up to connect with the ‘step leader’.

# *Development of Thunderstorms*



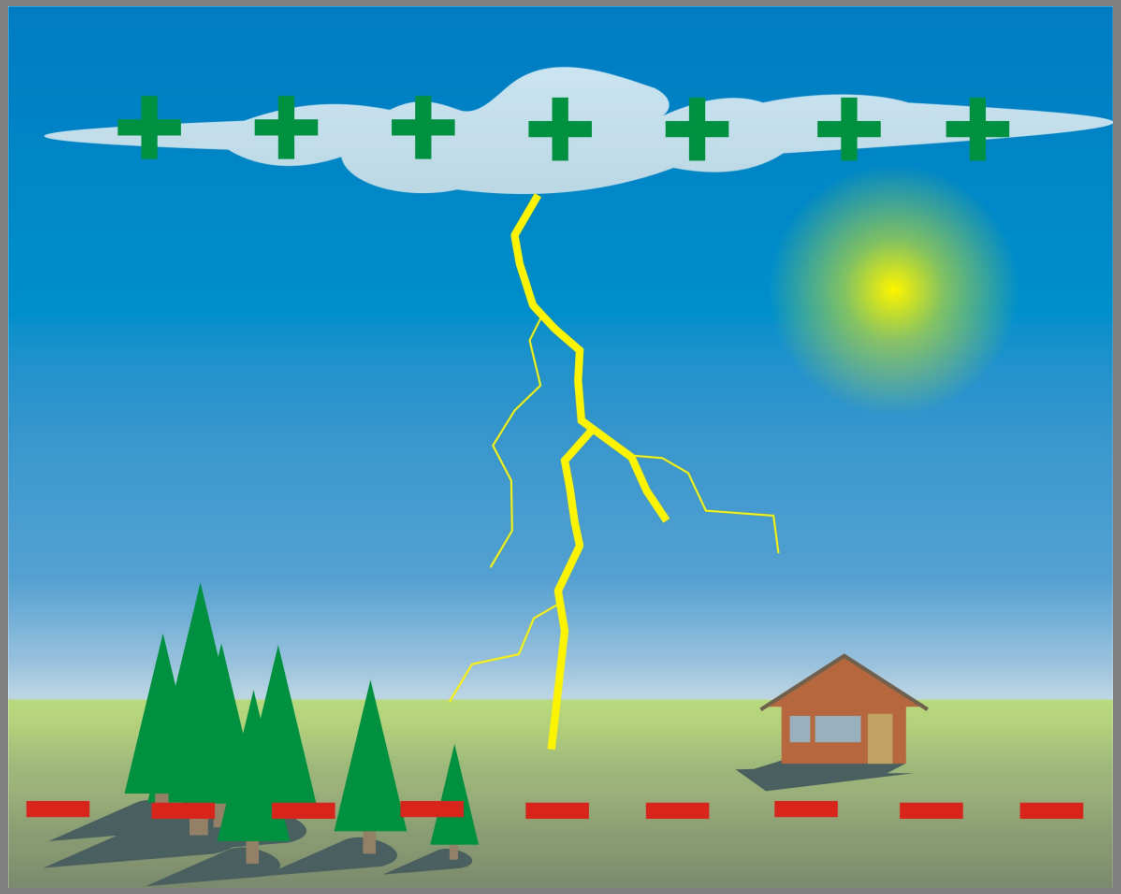
- Once the positive streamer reaches the ‘step leader’, a surge of electrical current moves from the ground to the cloud. This visible return surge is what we call lightning.
- As lightning passes through the air it heats the air to 50,000℃ in a few milliseconds.
- This causes the air to expand and contract rapidly. This rapid movement creates an audible effect we call thunder.

# *Development of Thunderstorms*



- ‘Negative flashes’ occur directly under the base of the cloud and may or may not be associated with rain.
- ‘Positive flashes’ occur away from the base of the cloud and can strike more than 15km from the cloud base.
- ‘Positive flashes’ occur in front and behind the storm.
- ‘Positive flashes’ are much greater in charge compared to negative flashes and are usually more damaging.

# *Development of Thunderstorms*



- As it rains, the storm starts to dissipate and the negative charges in the cloud disappear together with the positive charges on the ground.
- However, positive charges remain in the cloud and subsequently induce negative charges on the ground.
- These charges linger for as much as 30 minutes and may cause powerful ‘positive flashes’ from a seemingly harmless sky.

# *Characteristics of Thunderstorms*

- Dark clouds
- Dramatic increase in wind speed (gust front) up to 80km/h (Force 9)
- Dust clouds (if dust is available)
- Heavy rain & Hail
- Lightning & Thunder

# *Characteristics of Thunderstorms*

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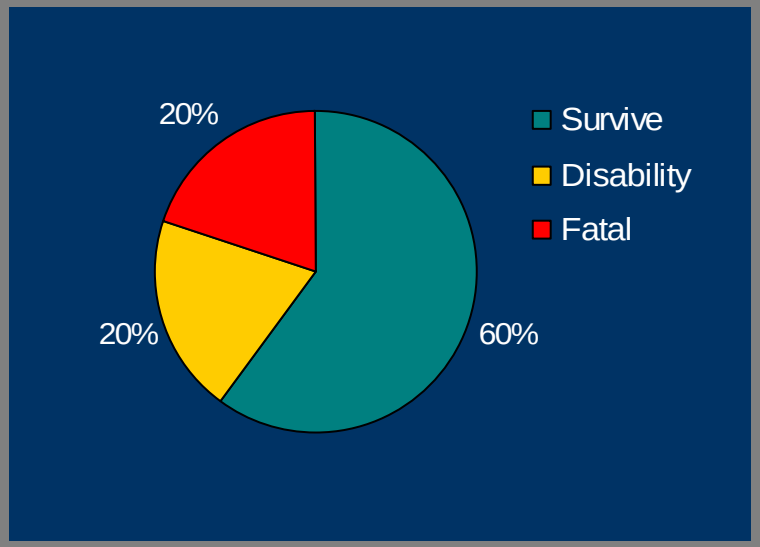
# *Some Facts about Lightning*

- 100 Lightning strikes to the Earth per second
- On land, 5 – 15 lightning strikes per sq.km/yr
- Originates 5 – 8km above sea level
- 100,000,000 Volts
- 10,000 – 200,000 Amps
- 20 – 300 microseconds
- Heats the air to 50,000℃ in a few milliseconds
- Known to strike more than 15km from the storm base
- Known to travel up to 100km within a storm

# *Lightning Accidents*

- It is unlikely that you'll be struck by lightning. Nevertheless, more people are killed by lightning than by any other storm related weather phenomenon with the exception of floods.




- Of all people struck by lightning:

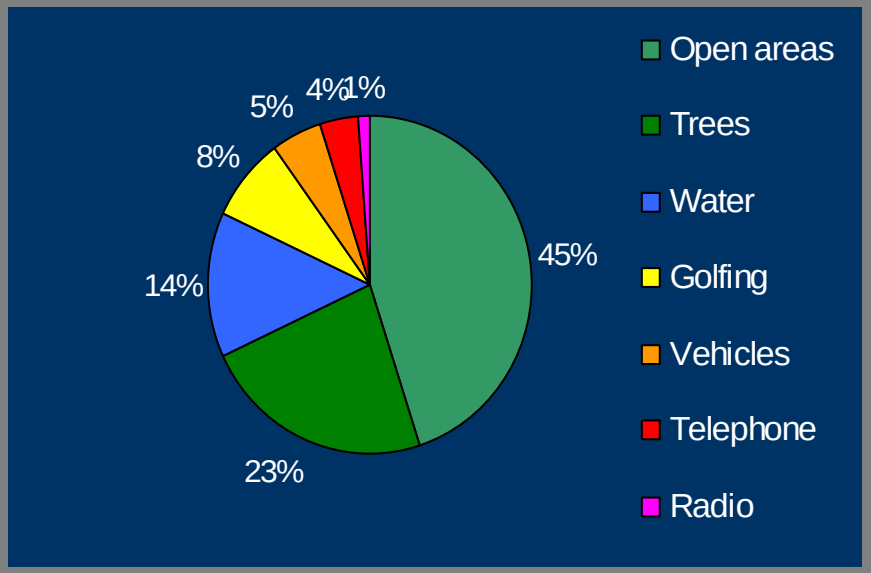
  60% survive without any long term effects
  20% survive but experience major long term effects
  20% die

- One third of lightning related injuries occur at work.
- One third of lightning related injuries occur during recreational or sports activities.
- One third of lightning related injuries occur in diverse situations, including to those inside a building.

# *Lightning Accidents*

Location / Activity

| | |
|---|---|
| Open areas (incl. sports fields) | 45% |
| Under trees (seeking shelter) | 23% |
| Water related (e.g. swimming, sailing) | 14% |
| Playing golf | 8% |
| Open farm and construction vehicles | 5% |
| Corded telephones (indoor) | 4% |
| Using radios | 1% |




# *Lightning Accidents*

- Most people are killed or injured by lightning due to misinformation and inappropriate behavior during thunderstorms

**i.e. fatalities and injuries were preventable**

- Many lightning casualties occur during the early stages, as the storm approaches because people ignore the precursors such as dark cloud cover, rainfall and high winds.

- Many lightning casualties occur during the last stages, as the storm dissipates because people no longer perceive a threat.

## When you hear thunder or see lightning you are at risk

When thunderstorms are in the area but not overhead, the lightning threat exists, even when it is sunny, not raining or when a clear sky is visible.

# *Lightning Hazards*

## Lightning strikes directly or indirectly

- Lightning may strike indirectly by branching off from buildings, power lines, trees, vehicles, people or through the ground.

- Only **substantial buildings** or **vehicles** with a metal roof (closed windows) will provide protection from lightning.

- However, lightning may enter a building in three ways:

  a. Directly through open doors, windows (either closed or open) and through walls.

  b. Indirectly through power lines, phone lines or plumbing.

  c. Indirectly through the floor (in case of a metal reinforced concrete floor, e.g. concrete slab).

- Lightning will damage equipment or injure people several meters from where it strikes through electrical surges. Surge protectors do **NOT** protect equipment from a lightning strike.

# *Being Struck by Lightning*

**Immediate effects:**

- Death
- Cardiac arrest
- Burns (usually an ‘entry’ and ‘exit’ burn)
- Loss of eye sight
- Loss of hearing
- Disorientation
- Shock

**Fractures or bleeding only occur when:**

- Victim is thrown a distance by the lightning strike.
- Victim is hit by fragments from e.g. exploding structures, machinery or trees.

**Long term effects:**

- Brain damage
  - **Loss of short term memory**
  - **Loss of the ability to store or retrieve information**
  - **Loss of the ability to do more than one thing at a time**
  - **Change in personality**
- Nervous system damage
- Muscle damage

# *Lightning Safety*

- Develop a lightning safety plan
- Provide Early Recognition via capable and approved detection devices
- Provide notification to all outdoor workers
- Evacuate workers to pre-designated safe shelters
- Threat reassessment and resume normal activities when safe to do so
- Install approved lightning protection defenses for buildings and structures where appropriate

# *Site Safety Plan Includes:*

- *Installation of Lightning Detection system*
- *Develop a policy for action when a storm is confirmed in the area.*
- *Train all employees on policy*

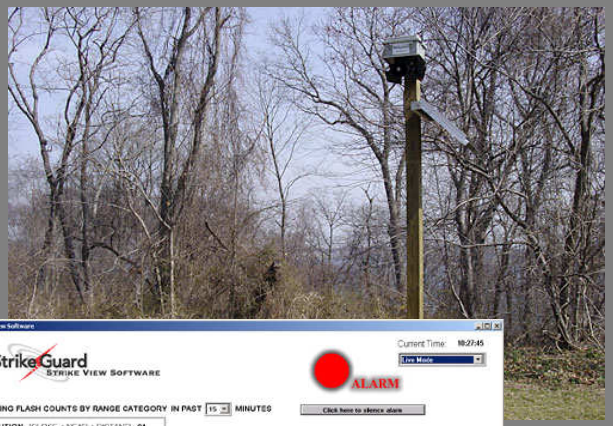
# Policy Includes Three Specific Alert Levels:

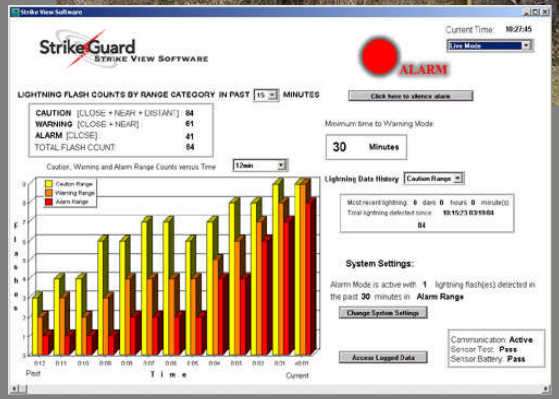
- Yellow Alert indicates that a storm is within range 16-32 Km from detection unit and will be communicated on all surface radio channels every 30 minutes.
- Orange Alert indicates that the storm is within a range of 8-16 Km, raises level of awareness , prompts employees to ensure shelter is identified along with required transport if required. This alert will be communicated on all surface radio channels every 15 minutes.
- Red Alert indicates that the storm is within close range 0-8 km and requires various changes in current work including, no work in the open, suspend loading activities in the open pit, suspend conveyance man travel or reduce it to half speed in an emergency situation.

The following video was produced as a result of a worksite fatal injury investigation with the intent to educate workers and as a training tool.

The video will be used as part of our training package for all employees.

- Lightning Video




StrikeGuard
Strike View Software
Current Time:
ALARM
LIGHTNING FLASH COUNTS BY RANGE CATEGORY IN PAST 15 MINUTES
Click here to silence alarm
CAUTION [CLOSE + NEAR + DISTANT] : 84
WARNING [CLOSE + NEAR] 61
ALARM [CLOSE] : 41
TOTAL FLASH COUNT 84
Minimum time to Warning Mode:
30 Minutes
Caution, Warning and Alarm Range Counts versus Time
12min
Lightning Data History
Caution Range
Caution Range
Warning Range
Alarm Range
Most recent lightning: 0 days 0 hours 0 minute(s)
84
System Settings:
Alarm Mode is active with 1 lightning flash(es) detected in the past 30 minutes in Alarm Range
Change System Settings
Access Logged Data
Communication: Active
Sensor Test: Pass
Sensor Battery: Pass
Flashes
Time
Past
Current

QUESTIONS????