Lightning and Thunder

- **Thunder is the sound lightning makes**

  - When you see a lightning flash, count how many seconds pass until you hear the thunder to find out how far away the lightning was
  - For every five seconds that pass, the storm is a mile farther away

Lightning

- Lightning most often occurs within a cloud or between clouds
- This type of lightning is often called sheet lightning and represents 80% of observed lightning
- The remaining 20% occurs between a cloud and the ground and is most dangerous to humans
- Thus, we will focus on cloud-to-ground lightning

Lightning

- Lightning forms when particles in the cumulonimbus clouds become charged and separate, with part of the cloud having positive charge, and part having negative charge
- It is not certain what causes the charge separation, but it is thought ice crystals have something to do with it
- But the cloud must have strong vertical motions and be very tall as well to get the separation
- So cumulonimbus clouds are needed

Lightning

- Usually the top part of the cloud gets a positive charge, with negative charge near the base (with small positive pockets)
- The negative charge at the base repels negatively charged particles at the Earth’s surface, leaving positively charged particles there

- **Fig. 10-15 (a)**
  - Eventually, the charge differences between cloud and ground become so great that even though air is a poor conductor of electricity, it is forced to break down and conduct
  - Lightning’s job is to take electrons from the cloud and give them to the ground to reduce the differences

The Lightning Stroke

- First, the nearly invisible step leader moves from the cloud toward the ground—laying out the path of least resistance the electrons will follow to the ground

- **Fig. 10-15 (b)**
  - Once the path is complete, the electrons can travel down the path from cloud to ground
  - The actual visible lightning stroke, however, is called the “return stroke” and travels from ground to cloud
  - Why?

Lightning Stroke

- The electrons empty out in sections from the bottom up
- The emptying happens really fast and creates the shockwave (thunder) and illumination (lightning) of the channel
- So depending how you look at it, lightning goes both from cloud to ground and ground to cloud

- **Fig. 10-15 (c) and (d)**
  - Several more return strokes are usually necessary to empty out all the negative charge in the cloud
  - The successive return strokes make lightning appear to flicker

Lightning Strokes—**Fig. 10-16**

More on Thunder

- When you see lightning but hear no thunder, the sound waves of thunder passed you by
- This lightning is often called “heat lightning” because people would see lightning in the distance on hot summer evenings, but never hear the thunder or even get the rain from the storm
Tornado Destruction

- The violent winds cause the damage, not the lower pressure
- So don’t waste time opening windows!
- Most human injuries and fatalities are due to being struck by flying debris

Tornado Intensity

**Tornadoes are rated using the EF-scale (Enhanced Fujita Intensity Scale)**

The EF-scale rates tornadoes based on wind speed estimates obtained from examining the damage wrought by the tornadoes

**Enhanced Fujita Scale**—Table 10-3

To see a table that relates the old Fujita Scale to the Enhanced Fujita Scale, try this web page: www.spc.ncep.noaa.gov/efscale/ef-scale.html

**EF-Scale Wind Speed Estimates**

- EF0—65-85 mph, EF1—86-110 mph, EF2—111-135 mph, EF3—136-165 mph, EF4—166-200 mph, EF5—above 200 mph
- You CAN compare tornadoes rated on the old scale to tornadoes rated on the new scale. For example: a tornado rated an F5 on the old Fujita Scale was the same level of intensity as a tornado rated an EF5 on the new scale, but the wind gusts we estimated were present in the tornado have been revised.

Tornado Destruction

**The majority of tornadoes are weak (EF0 – EF1)**

- In fact, you should be just as worried about damaging winds from a bow echo as you are about weak tornadoes
- **It’s the rare violent tornadoes that cause most of the damage and deaths**

**Tornado Intensity/Fatalities**—Fig. 10-27

So Be Careful!

- When a tornado warning is issued, take shelter! Lowest level of home, interior room away from windows, under the staircase if you have to!
- If outside, do NOT go under overpasses!
- If the tornado truly hits there, debris will pile up against the sides and injure/kill you

**Bein’ Careful**

- A ditch/culvert can have the same problem, with debris falling into it, but it’s probably not as bad as the overpass
- Just get out of the car and lie flat on the ground
- However, if you see the tornado soon enough, and you know where you are, if you can drive on a road perpendicular to, and away from, the tornado’s path, it would be safest to outrun it that way

**Lightning Safety**

- You are not safe from a lightning strike until 30 minutes have passed since the last strike
- But, more injuries from lightning occur when people wait too long to take shelter
- As soon as you see the first flash, go inside, it’s THAT SIMPLE!
- Lightning can often arc sideways and then down, so it doesn’t always strike the ground directly underneath the cloud—meaning it can strike the ground in areas that are not cloudy (a “bolt from the blue”)
- So basically, if you see a lightning flash, the storm is close enough to you that the next flash could be right on top of you!