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Storms Assignment

1. What is the most likely reason for reading this article?
   * To learn more about the circumstances under which lightning can be hazardous to people
2. Which overarching theme of this course is targeted in this reading?
   * Characterizing potential consequences to individuals, communities or property.

Summary of Articles

## Total number of Incidents

* 445 known incidents of lightning strike on people from 1988 to 2012 (18 per annum), this however is an underestimate.
* 28% of incidents involve more than one person, totaling to 722 people struck, averaging 29 per year
* Highest recorded in a year was in 1994, where 83 people are struck
* For the period of 2006 to 2011 average of people struck are 63 per year

## Lightning’s potential to cause injury

Cloud to ground lightning may cause:

### Direct strike

Although high-voltage, lightning only touches a person in milliseconds, it may pass over a person's skin or clothes without penetrating skin (flashover effect).

Other strikes may penetrate the skin and cause burns and damage to internal organs such as brain, heart, and lungs . A direct strike leads to most or all of the electrical discharge penetrating the body instead of flashing over, although wet skin or clothes provide better flashover path.

Flashover effect sometimes creates a fern-like erythema (reddening of skin) called Lichtenberg figure. Electrons radiate outward from successive points in the epidermis creating a fractal pattern, usually appears half an hour or several hours after the strike, not a burn and will disappear within a few hours to 48h.

Carrying a metal object doesn’t increase likelihood of being struck, but may cause burns as the metal heats up very quickly.

Wearing earphones or using mobile phones will disrupt flashover effect and cause lightning to enter the head.

Burns may become worse if hair catches on fire or polyester clothing/ plastic melts.

Sweat may evaporate and cause burns too

## Contact Voltage

Occurs when a person comes in contact with an outdoor object struck by lightning or an indoor object part or a conducting route to reach the ground. Similar effects are seen to that of a direct strike. Indoor victims are subject to less current, because electrical appliances are protected with surge protectors or because lightning may take several routes to reach the building.

## Side Flash

Lightning strikes an object and splash to a nearby person because they provide a better conductive route to the ground. Effects are like that of contact voltage

## Step Voltage (ground current)

Lightning strikes the ground or a post and current spreads outward like a ripple effect. Voltage differential is created between a person’s feet (if they are in the field), causing current to flow up one foot down the other. Leg muscles spasm violently (may cause person to be thrown off feet. Leg paralysis may occur.

Current experienced Is greater the further away the feet and the more right angles the person is to the ripple, the closer the strike point and higher the current, voltage, and duration of lightning and the higher the resistivity of soil.

People up to 30m away may be affected. Often effects are less serious than direct strike

## Upward streamer not connected to a downward stepped leader

Unconnected upward streamer causes hair to stand and objects to buzz or crackle. Streamer discharges from upper part of body and so effects on head is concerning( particularly the eyes). Current from unconnected upward streamers are a fraction of a direct strike.

## Subsequent electrical discharge from an insulated object

Metal roof or platform insulated from the ground may retain electrical charge, if a person touches them, then charge is discharged through them the ground.

Lightning may cause injuries through nonelectrical ways:

* Sudden expansion of air may cause blunt force trauma.
* Pressure or shockwave may rupture eardrums, and damage soft tissues
* Magnetic fields may cause intense but short lived electrical currents causing heart to stop or ventricular fibrillation
* Falling rooftiles or masonry from damaged buildings.
* Fires from overheating electrical appliances may cause burns and smoke inhalation.
* Lightning flashes temporarily blinds driver and they crash
* Lightning startles animals and stampedes people
* Tree zap evaporized and branches burst killing people

# Outdoor vs Indoor accidents

54% of lightning incidents are outdoors, accounting for 64% or people struck.

# Video Summary

* Direct strike is the most powerful, delivers 5-200000 amps. Most likely to hit people out in the open. Chances of surviving almost zero.
* Side flash, lightning strikes a tree and then hits you. May contain just as much current as direct strike. Cannot jump more than 2 meters from the object.
* Ground strike – lightning strikes ground and travels in circles. Each circle is equal in voltage. Standing parallel to the circle may cause less shock as opposed to standing at right angles to the circle, because it creates voltage difference. Less likely to kill people. Animals like cows are more likely to get killed because feet are far apart, more voltage passes through the cow and passes its heart.
* Michael got struck at least 20m from any tall object, so not possible for side flash. Not ground strike, because partners didn’t feel a thing , so Michael got a direct strike. He survived. There was a slash mark, from the strike. The putter was involved in routing the lightning

## Answers to Questions

### Step 2

1. Match the mechanism of lightning strikes to type of lightning strike

* A – vi
* B - iv
* C – ii
* D – iii
* E – v
* F – i

1. Match lightning phenomenon to type of injury

* A – ii
* B – i
* C – iv
* D – v
* E – iii

1. Which aspects is not mentioned in article

Whether victims were harmed before, during or after the peak of the storm

1. Which phenomenon does the video suggest may have allowed Michael to survive a direct lightning0020strike?

Current may have flowed from his body to the golf club.

1. From the article, what is the reason suggested for the higher proportion of outside events involving males

More men than women were engaged in outdoors work or recreation activities.

1. Which of the following phenomena was described in the article but not in the video? An alternative as to why Michael might have survived.

Flashover effect

1. What general conclusion can be generally drawn from the decline in incidents for the period 1988-2012?

Effective public education

1. Which single judgment error is most likely to result in serious injury when a lightning-inducing storm?

Sheltering near or under a tree

1. Which of these distances (in m) from a tree is the largest that might still result in experiencing potential effects of current flowing in the ground?

29

1. Staying the recommended distance away from a tree is recommended because

That would place you further than the distance a potential side flash could cover

1. Consider locations “b” and “c”. If a lightning strikes t1, then b would be more dangerous because it is closer from the tree than the alternative
2. If you are standing at location d, lightning strike tree t1 would be less dangerous because

Feet are oriented so as to result in a lower voltage across them

1. Consider locations “d” and “e”, if lightning strikes T2, e would be more dangerous because

Foot spacing is wider

1. The photo shows main mall looking UBC. Show the location that is most preferable to least preferable

* 2 – Where the two people are walking
* 3 - Centre of the grassy middle
* 4 – Inside ESB or Beaty
* 1 – Where one person is walking

### Step 4

1. The database is built from reported incidents. Yields an average of 29 people per year experiencing a lightning strike.

This is somewhat less that true average

1. If you are in forest or a park with several trees around you during a thunderstorm, you would not know which tree to be struck.

You cannot anticipate which the best direction to face.

### Step 5

1. Our article’s main purpose FALSE
2. Central message is constructed from pre-existing litereature TRUE
3. Reading is targeted mainly to non-scientific audience TRUE
4. Content is presented in a non-technical manner FALSE
5. This article is a peer-reviewed journal TRUE
6. Main purpose of article
   1. A communication about science written to inform non-specialists and enhance their safety

What writing strategies are used in this article?

* Assertions are supported based on evidence based on obseervations gathered by other scientists TRUE
* Narrative or personal stories were incorporated into the article FALSE
* The author targeted human emotions as a part of writing strategies FALSE
* Descriptions of aesthetic aspects are included FALSE
* The author identified uncertainties and incomplete aspects TRUE

Next, we consider the different types of “claims”

* The claim “The average number of deaths for the period 1988-2012 in the UK was around half of that of the period from 1960s – 1980 could be described as

An observation or something measured

* Lightning victims can experience long term health consequences

Conclusion or theory

* The claim “From 1988 to 2012 an average of 29 people were estimated to have experienced an electrical shock due to lightning :

Value based on calculations using parameters

* Intense magnetic fields may induce… :

Hypothesis

* This article has different purpose compared to other articles, it can be characterized as:

Uses scientific understandings to inform

* Data used as a part of any scientific study can be acquired in several ways.

What kind of data are dates of events obtained from historical records?

Gathered – needed to be collected from people

* What kind of data are lengths of side-flash arcs obtained from high-speed photographs

Measured with instruments

* Tiny-circular burn marks

Observed -not measured

* What kind of data is circles in video?

Simulated or modeled