

# 19<sup>th</sup> Annual School Day at the “K” 2017

## Thursday, May 4, 2017

### **FOX 4 Weather Questions**

(Updated: November 11, 2016)

I hope you enjoy this study guide for you to use in your classrooms! The answers to each question can be found at the end of this guide, with a brief explanation of the answer to each question. Thanks for coming to FOX4 for your weather needs...and for your participation in the School Day at the “K” program!

Mike Thompson  
Chief Meteorologist  
FOX4

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#### **Basic Tornado Knowledge:**

1. What time of day is tornado ‘Prime Time?’
  - a. 10 a.m. to 2 p.m.
  - b. Noon to 4 p.m.
  - c. 4 p.m. to 8 p.m.
2. In which direction do most tornadoes spin?
  - a. Clockwise
  - b. Counter-clockwise
  - c. Both
3. About how long do most tornadoes last?
  - a. 1 minute
  - b. 10 minutes
  - c. 30 minutes
4. What is the highest wind speed ever recorded inside a tornado?
  - a. 118 mph
  - b. 218 mph
  - c. 318 mph
5. About how many tornadoes occur in the United States each year?
  - a. 300
  - b. 800
  - c. 1,300

6. Every year, your chance of having a tornado pass within 25 miles of your home is:
  - a. Less than 1%
  - b. 30%
  - c. 50%
  
7. A tornado warning means:
  - a. A tornado is likely or has been spotted
  - b. A tornado might form
  - c. A cloud that looks like a tornado has been seen
  
8. A tornado watch means:
  - a. You will have a tornado
  - b. A tornado is occurring
  - c. A tornado is possible
  
9. When are tornadoes most likely to occur around the Kansas City area?
  - a. March 7 to April 17
  - b. April 17 to June 7
  - c. June 7 to July 7
  
10. Bigger tornadoes are always stronger than smaller tornadoes?
  - a. True
  - b. False
  
11. A tornado is only called a tornado if:
  - a. You can see the funnel cloud
  - b. Violently spinning air reaches the ground
  - c. Damage to buildings occur
  
12. What is the average width of a tornado?
  - a. 100 yards
  - b. 160 yards
  - c. 220 yards
  
13. In which month is Kansas City least likely to be hit by a tornado?
  - a. December
  - b. January
  - c. February
  
14. Tornadoes usually form in the part of a thunderstorm where:
  - a. There is little or no rain
  - b. There is moderate rain
  - c. There is heavy rain

15. Doppler Radar can always identify a tornado:
- True
  - False
16. If you have no basement in your home, where is the best place to take shelter?
- Lowest Floor
  - Center of the home
  - Away from windows
  - All of the above
17. Which is **not** the same as a tornado?
- Twister
  - Waterspout
  - Funnel Cloud
18. Which storm has the most powerful winds?
- Hurricane
  - Tornado
  - Microburst
19. The main question tornado chasers are trying to answer is: How do tornadoes \_\_\_\_:
- Start
  - Get so big
  - End
20. Does cloud seeding affect storm and tornado formation?
- Yes
  - No
  - Sometimes

### **Basic Storm Knowledge:**

21. About how many thunderstorms occur around the world each year?
- 1,600
  - 160,000
  - 16,000,000
22. About how wide is a lightning bolt?
- ½ inch
  - 2 inches
  - 5 inches
23. You are most safe from lightning:
- In a car
  - Under a tree
  - In your house

24. You are in danger of being hit by lightning as soon as:
  - a. You see it
  - b. You hear thunder
  - c. Rain begins to fall
  
25. If you get caught outside during a thunderstorm, and you have no other place to take cover, which of these is the safest option?
  - a. Stand close to a group of people
  - b. Stand under a single tree
  - c. Stand under a group of trees
  
26. How hot is a lightning bolt?
  - a. 500 degrees Fahrenheit
  - b. 5,000 degrees Fahrenheit
  - c. 50,000 degrees Fahrenheit
  
27. How many times a year, in the United States, does lightning strike?
  - a. 300,000 times
  - b. 3,000,000 times
  - c. 30,000,000 times
  
28. Which state is considered the lightning capital of the United States?
  - a. Texas
  - b. Florida
  - c. Alabama
  
29. How fast does a lightning bolt travel?
  - a. 100,000 miles per second
  - b. 1,000 miles per second
  - c. 100 miles per second
  
30. Severe thunderstorms have produced hail as large as:
  - a. Baseballs
  - b. Softballs
  - c. Soccer Balls
  
31. About how many hailstorms occur in the United States each year?
  - a. 480
  - b. 4,800
  - c. 48,000
  
32. What is the highest wind gust ever recorded during a microburst?
  - a. 150 mph
  - b. 100 mph
  - c. 50 mph

33. What is the world record for rainfall in one hour?
- 12 inches
  - 8 inches
  - 4 inches
34. Floodwaters moving at just 8 miles per hour, can put this much weight on a 12 inch by 12 inch square:
- 64 pounds
  - 164 pounds
  - 264 pounds
35. A very strong gust of wind that drops from a thunderstorm is called:
- An Eddy
  - A Microburst
  - A Squall
36. A long line of intense thunderstorms traveling together is called a:
- Gust Front
  - Cold Front
  - Squall Line
37. Lightning can cause flashes of light that shoot out the top of thunderstorms called:
- Red Sprites
  - Blue Colas
  - Green Pibbs
38. How fast do hailstones fall?
- 70 mph
  - 100 mph
  - 150 mph
39. In general, the stronger the thunderstorm, the greater the:
- Amount of lightning
  - Areal Coverage of the storm
  - Size of raindrops
40. Polarimetric radar known as dual pole radar, was introduced nationwide in 2011, it more accurately measures:
- Tornadoes
  - Hail
  - Lightning
41. Inside a cloud, this substance is a very important ingredient in the formation of lightning:
- Dust
  - Ice
  - Water Droplets

42. When lightning strikes it releases this gas into the atmosphere:
- Nitrogen
  - Carbon Dioxide
  - Oxygen
43. What type of weather kills the greatest number of people each year?
- Lightning
  - Heat
  - Flooding

### **General Meteorology/Climate:**

44. Most of the sun is made out of:
- Hydrogen
  - Helium
  - Propane
45. If there were no atmosphere, the afternoon highs on earth would be:
- 225 degrees F
  - 50 degrees F
  - 243 degrees F
46. What gas is responsible for at least 90% of the earth's "greenhouse effect" warming?
- Carbon Dioxide
  - Water Vapor
  - Methane
47. How much of the earth's "greenhouse effect" warming is caused by carbon dioxide?
- 50%
  - 20%
  - 10%
48. What is the most abundant gas in the earth's atmosphere?
- Oxygen
  - Nitrogen
  - Argon
49. As a percentage, about how much of the earth's atmosphere is in the form of water vapor, in various forms (clouds, humidity, etc.,) at any one time?
- 50%
  - 20%
  - 4%

50. How much carbon dioxide in the earth's atmosphere comes from natural sources (not from humans)?
- 3%
  - 50%
  - 97%
51. How much of the Earth's surface is covered by water?
- More than 70%
  - 50%
  - Less than 30%
52. What job do hurricanes perform to keep the earth's temperature in balance?
- Stir up the oceans
  - Transfer heat from the tropics toward the poles
  - Cool the air with rain
53. Global Carbon Dioxide levels have never been higher:
- True
  - False
54. The earth's temperature was warmest in what year?
- 1998
  - 1834
  - 1934
55. What is the difference between weather and climate?
- The location
  - The season of the year
  - The period of time involved
56. Research has shown a greater chance for severe weather during this type of climate event:
- El Niño
  - La Niña
  - Monsoon
57. Since 2004, the amount of radiant energy the earth receives from the sun has:
- Risen
  - Remained the same
  - Dropped
58. If all of the sea ice on earth melted, how much would the sea level rise?
- Zero
  - Two Feet
  - Six Feet

59. The average temperature of the earth is:
- 59 degrees
  - 65 degrees
  - Nobody Knows
60. When air pressure falls, winds usually:
- Increase
  - Decrease
  - Stay the same
61. The wind near the center of a high pressure area usually is:
- Very strong
  - From the North
  - Very light
62. Weather forecasting is mostly a study of:
- Geography
  - Math
  - Physics
63. The Earth has always had oxygen in the atmosphere:
- True
  - False
64. The amount of energy the Earth receives from the sun is constant:
- True
  - False
65. Bacteria influence our climate:
- True
  - False
66. Solar cycles impact how much of this forms on the Earth:
- Carbon Dioxide
  - Rain
  - Cloudiness
67. What does atmospheric (barometric) pressure measure?
- How much air is overhead
  - How much the air overhead weighs
  - How much moisture is in the air
68. A falling barometric pressure indicates:
- A storm is brewing
  - Skies will clear
  - Air is getting lighter

69. Where would you expect to typically have lower air pressure?
- Miami, Florida
  - Kansas City, Missouri
  - Denver, Colorado
70. Wind direction can be affected by:
- Low air pressure
  - Location
  - Earth's Rotation
  - All of the above
71. Wind speed increases as:
- Air pressure rises
  - Air pressure drops
  - Both
72. Air tends to flow from:
- Lower pressure toward higher pressure
  - Hotter air toward cold air
  - Lower latitudes toward higher latitudes.
73. Relative humidity refers to the amount of moisture in the air relative to:
- Air Pressure
  - Wind Flow
  - Air Temperature
74. The Dew Point is a good way to estimate:
- How much moisture is in the air
  - What time dew may form
  - When precipitation will form
75. Storms in the southern Hemisphere tend to move:
- From West to East
  - From East To West
  - Neither
76. The atmosphere near the equator is:
- Thicker than near the North Pole
  - Very calm
  - Hotter than Arizona
77. The air located just above where the weather forms, is a layer called the:
- Mesosphere
  - Ionosphere
  - Stratosphere

78. Where does the atmosphere end and outer space begin?
- 6 miles high
  - 620 miles high
  - 6,200 miles high
79. What do you call the layer of the atmosphere where all the weather (storms, rain, snow, etc) occurs?
- Stratosphere
  - Troposphere
  - Mesosphere
80. How deep is the troposphere?
- 2 to 8 miles
  - 3 to 10 miles
  - 5 to 12 miles
81. The only clouds that reach the stratosphere are:
- Stratus
  - Altostratus
  - Cumulonimbus
82. This gas forms in and heats up the stratosphere:
- Ozone
  - Argon
  - Methane
83. How high is the stratosphere?
- 4 to 12 miles high
  - 6 to 18 miles high
  - 8 to 24 miles high
84. Which layer of the atmosphere helps stop meteors from reaching the Earth?
- Exosphere
  - Ionosphere
  - Mesosphere
85. How high is the Mesosphere?
- 31 to 53 miles high
  - 41 to 150 miles high
  - 51 to 250 miles high
86. What is the hottest part of the Earth's atmosphere?
- Troposphere
  - Thermosphere
  - Stratosphere

87. How high is the Thermosphere?
- 43 to 275 miles high
  - 53 to 375 miles high
  - 63 to 475 miles high
88. How high do temperatures climb in the Thermosphere?
- 62 degrees
  - 620 degrees
  - 6,200 degrees
89. What is the part of the Earth's atmosphere that makes receiving radio signals possible?
- Ionosphere
  - Troposphere
  - Mesosphere
90. This phenomenon occurs in the Ionosphere:
- Sunspots
  - Auroras
  - Lightning
91. The space shuttle orbits the Earth in this layer of the atmosphere:
- Stratosphere
  - Mesosphere
  - Thermosphere
92. The top of the atmosphere where atoms and molecules escape into space, and where satellites orbit the Earth, is called the:
- Exosphere
  - Thermosphere
  - Ionosphere
93. How much dust from outer space settles onto the Earth each year?
- 80,000 pounds
  - 8,000 pounds
  - 800 pounds
94. The amount of dust falling onto Earth from outer space is affected by:
- Our location in the galaxy
  - Sunspots
  - Both
95. Ice ages happen on Earth about how often?
- Every 200 years
  - Every 1,200 years
  - Every 12,000 years

96. Global warming and global cooling are:
- a. Natural cycles
  - b. Beyond man's control
  - c. Both

### **Weather Trivia:**

97. Which state has had the greatest number of long track tornadoes?
- a. Kansas
  - b. Missouri
  - c. Oklahoma
98. What American singing star was nearly killed by a tornado?
- a. Elvis Presley
  - b. Ashley Simpson
  - c. Hannah Montana
99. What is the highest number of tornadoes ever to occur in one day?
- a. 48
  - b. 148
  - c. 200
100. When was the earliest known film of a tornado taken?
- a. 1933
  - b. 1953
  - c. 1973
101. Which city has been hit by tornadoes more often than any other city in the world?
- a. Oklahoma City, Oklahoma
  - b. Dallas, Texas
  - c. Kansas City, Missouri
102. The first organized scientific storm chasing began in:
- a. 1992
  - b. 1972
  - c. 1952
103. What is the record for how far one tornado has traveled on the ground?
- a. 35 miles
  - b. 135 miles
  - c. 235 miles
104. What is the record for the widest tornado?
- a. 2.6 miles
  - b. 1 mile
  - c. .5 miles

105. What is the record number of tornadoes reported in the U.S. in one month?
- 358
  - 558
  - 758
106. What is the thinnest known tornado at ground level?
- 3 feet
  - 10 feet
  - 20 feet
107. Tornadoes have been known to move, or pick up, items as heavy as:
- 300 pounds
  - 3,000 pounds
  - 30,000 pounds
108. Which weather phenomena kills more people in the U.S. every year?
- Floods
  - Lightning
  - Tornadoes
109. Like thunder-snow, tornadoes can form in a snowstorm:
- True
  - False
110. Tornadoes are most common in the United States, and this country:
- Canada
  - England
  - Australia
111. What is the hottest temperature ever recorded in the United States?
- 114 degrees
  - 124 degrees
  - 134 degrees
112. What is the hottest temperature ever recorded in Kansas?
- 131 degrees
  - 121 degrees
  - 111 degrees
113. What is the hottest temperature ever recorded in Missouri?
- 108
  - 118
  - 128

114. What is the coldest temperature ever recorded in the United States?
- 100
  - 90
  - 80
115. What is the coldest temperature ever recorded in Kansas?
- 40
  - 50
  - 60
116. What is the coldest temperature ever recorded in Missouri?
- 40
  - 50
  - 60
117. What is the hottest temperature ever recorded in the world?
- 144
  - 134
  - 124
118. What is the world's fastest wind gust...not associated with a tornado or hurricane?
- 131 mph
  - 231 mph
  - 253 mph
119. What is the world's greatest 1-hour rainfall record?
- 6 inches
  - 12 inches
  - 24 inches
120. The Fahrenheit and Celsius temperature scales meet at this temperature:
- 32 degrees
  - 100 degrees
  - 40 degrees
121. At what temperature does the air become too cold to hold water vapor?
- 40 C
  - 100 C
  - 273 C
122. What temperature scale has no negative numbers?
- Celsius
  - Kelvin
  - Fahrenheit

123. Temperatures at cloud level are not made completely from ice crystals until the cloud approaches this temperature:
- 10 C
  - 20 C
  - 40 C
124. Very dry air heats and cools about this much faster than very humid air:
- Half as fast
  - Twice as fast
  - No Difference
125. Is it possible for ice to freeze to a temperature of absolute zero?
- Yes
  - No
  - Maybe
126. In an average year, how many EF5 tornadoes are there?
- 0 to 1
  - 1 to 3
  - 3 to 6
127. On average, how many tornadoes occur in Kansas each year?
- 78
  - 48
  - 28
128. On average, how many tornadoes occur in Missouri each year?
- 39
  - 49
  - 59
129. On average, how many tornado related deaths occur in Kansas each year?
- 6
  - 2
  - 0
130. On average, how many tornado related deaths occur in Missouri each year?
- 8
  - 4
  - 3
131. What is the average annual death toll from tornadoes in the United States each year?
- 106
  - 56
  - 36

132. What was the deadliest year on record for tornadoes?
- 2011
  - 1950
  - 1925
133. On average, when is the first tornado of each year reported?
- January 11
  - February 11
  - March 11
134. Of the top 25 deadliest tornadoes on record, which state has the most?
- Kansas
  - Missouri
  - Oklahoma
135. Before 1950, forecasting tornadoes was banned because of the fear that predicting tornadoes:
- Would cause panic
  - Would not be correct
  - Could get them in trouble
136. What is the record number of EF4 rated tornadoes in one year?
- 16
  - 26
  - 36
137. What is the record number of EF5 rated tornadoes in one year?
- 7
  - 17
  - 27
138. Which year holds the record for the least number of tornadoes?
- 2011
  - 2012
  - 2013
139. Which year holds the record for the most number of tornadoes?
- 2011
  - 2012
  - 2013
140. A new world record for the coldest temperature on Earth was set in 2013. What was the temperature reading?
- 128.6
  - 135.8
  - 150.0

## **Weather Observation/Earth Science:**

141. Fog is:

- a. A cloud that forms at ground level
- b. Excessive dust at ground level
- c. Ozone that forms at ground level

142. In meteorology, the measure of distance which an object can be seen clearly is called:

- a. Focal Point
- b. Ceiling
- c. Visibility

143. What is the most important factor that determines how much moisture air can hold?

- a. Temperature
- b. Pressure
- c. Available moisture

144. How many basic cloud types are recognized?

- a. 5
- b. 12
- c. 27

145. What determines the cloud type?

- a. Shape
- b. Height
- c. Appearance
- d. All of the above

146. What is the name of the rare cloud that forms higher in the sky than any other?

- a. Noctilucent
- b. Nacreous
- c. Pileus

147. Which rare cloud is seen mainly in northern latitudes and is called the “Mother of Pearl” cloud?

- a. Noctilucent
- b. Nacreous
- c. Pileus

148. When more than 5/8 of the sky is covered by a layer of clouds, that layer is considered to be the:

- a. Base Layer
- b. Obscuration
- c. Ceiling

149. Knowing the height of the base (bottom) of a cloud layer is important for:
- Aviation Concerns
  - Tornado Formation
  - Precipitation Type
  - All of the above
150. If you viewed the Earth from directly above the North Pole, which way would you see the earth rotate?
- Counter-clockwise
  - Clockwise
151. How long does it take the light from the sun to reach the Earth?
- 8.3 seconds
  - 8.3 minutes
  - 8.3 hours
152. What is the distance between the Earth and the sun at aphelion (the day each year when the sun and Earth are farthest apart)?
- 94,512,904 miles
  - 92,785,950 miles
  - 91,403,812 miles
153. What is the distance between the Earth and the sun at perihelion (the day each year when the sun and Earth are closest together):
- 94,512,904 miles
  - 92,785,950 miles
  - 91,403,812 miles
154. The beginning of each season (summer, spring, etc.) is determined by:
- The position of the sun relative to Earth
  - The position of the moon relative to Earth
  - Earth's Rotation
155. How much of the Earth's land surface is covered by desert?
- 13%
  - 23%
  - 33%
156. How much of the Earth's surface is covered by water?
- 61%
  - 71%
  - 81%

157. What is the largest hot desert on Earth?
- Mojave
  - Great Victoria
  - Sahara
158. What is the largest cold desert on Earth?
- Antarctica
  - Patagonia
  - Gobi
159. What is the largest desert on Earth?
- Antarctica
  - Sahara
  - Atacama
160. What is the largest ocean on Earth?
- Atlantic
  - Pacific
  - Indian
161. What is the deepest ocean on Earth?
- Atlantic
  - Pacific
  - Arctic
162. What is the highest mountain on Earth (above sea level)?
- Annapurna
  - Mt. Everest
  - Mt. Elbert
163. What is the tallest mountain on Earth?
- Mauna Kea
  - Cho Oyu
  - K2
164. What is the largest Continent on Earth?
- North America
  - Europe
  - Asia
165. What is the smallest continent on Earth?
- Australia
  - Antarctica
  - Europe

# School Day at the “K” 2016

## Quiz Question ANSWERS

### Basic Tornado Knowledge:

1. b.--**Noon to 4 p.m.**...Hot, humid air is necessary for thunderstorm formation...and to have tornadoes, you have to have thunderstorms. During the afternoon hours, the temperature normally reaches its peak. The heat of the day causes the air to rise, carrying moisture high into the sky, then turning it into the towering thunderclouds that produce severe weather, including tornadoes! Severe storm season, for our area, runs from mid-April to mid-June. As spring turns to summer, the jet stream, another key ingredient in tornado formation, shifts northward, removing one of the factors needed to form tornadoes. The heat and humidity remain, of course, but tend to boil up storms that are less likely to produce tornadoes!
2. b. -- **Counter-clockwise**...Most tornadoes in the northern hemisphere of the earth spin counter-clockwise. On occasion there will be tornadoes that spin in the opposite direction...but they are fairly rare.
3. b.--**10 minutes**...Although there are always exceptions to every rule, the **average** tornado lasts for about 10 minutes! Many are shorter lived, and a few have lasted for several hours. Tornado “families,” series of tornadoes from one thunderstorm complex, can last for over 10 hours in major outbreaks!
4. c.--**318 MPH**...Several tornadoes have reached a top speed around 318 mph, but none has ever gone higher, that we know of. If a tornado would ever reach measured wind speeds of 319 mph, it would be the world’s first F-6 tornado!
5. c.--**1,300**...During the years prior to radio and TV, it was thought that there were not as many tornadoes as we know now to exist each year. Now, with information spread rapidly via radio, TV, and the internet, it is easier to learn of tornadoes that have touched down, and gather information about storms. Better methods of tornado tracking on radar and improved tornado confirmation processes, have given us a more accurate picture of how many twisters form each year. By the way, the United States, because of its unique geography, is the tornado capital of the world!
6. a. -- **Less than 1 percent**...Believe it or not! While we hear a lot about tornadoes, it is unlikely that one will ever strike your home. And, unless you go looking for a tornado, you may never see one...even if you do live here in “tornado alley”!

7. a.--**A tornado is likely or has been spotted**... When a tornado warning is issued, it means a tornado has been spotted, or one is indicated on radar. When a warning is issued for your area, it does not necessarily mean that the tornado will hit you, but it may be nearby! You should never ignore a tornado warning, but it's best not to panic over one either. If you follow the tornado safety rules, you will likely survive the tornado. In fact, thanks to faster and more accurate tornado warnings that we can provide you now, the death toll from tornadoes is now under 50 persons per year!
8. c.--**A TORNADO IS POSSIBLE**... A tornado watch simply means the conditions are right for tornado formation. But there are many times when a tornado never forms in a tornado watch area. All we ask is that you remain alert to the possibility to a tornado, be prepared to take action if one is spotted, and tune to FOX4 for any warnings!
9. b.--**April 17 to June 7** is our prime tornado season! Tornadoes can, and do form in other times of the year as well, even in winter! But, from mid-April to mid-June, everything needed to form tornadoes is most frequently present in the atmosphere near our area. After mid-June, the Jet Stream, which is one of the prime ingredients for tornado formation, tends to shift northward, reducing the threat for tornado producing thunderstorms!
10. b. -- **False**... Smaller sized tornadoes can produce damage just as bad as tornadoes larger in scale. They may not cover as much area, but the winds are often just as violent.
11. b. -- **Violently Spinning Air Reaches the Ground**... There are many tornado "lookalikes" that are often mistaken for tornadoes. Even trained spotters can be fooled by the familiar funnel shape of clouds that look like tornadoes, but are not. Tornadoes that remain aloft, are called funnels, and are usually part of something called a wall cloud... but until they touch down, they are not officially a tornado. Sometimes the spinning air of a tornado reaches the ground, and the connecting cloud between the ground and the base of the parent thunderstorm is not visible. That is still considered a tornado. Often tornadoes touch down in remote areas where there are no buildings, and damage is minimal, but it is still classified as a tornado regardless of damage.
12. b. -- **160 yards**... While tornado size and shape can vary widely, the average, or typical tornado usually is about 160 yards wide. That's not quite two football fields wide ... certainly wide enough to take out a half dozen houses all at once!
13. b. -- **January** ... Statistically, the likelihood of a tornado in the Kansas City region drops to its lowest point during the first 20 days of the year. By February, storm season is underway in the southern United States, and more active storms begin to migrate northward!

14. a. -- **Little or no rain** ...Tornadoes form in areas of updrafts, where the air is trying to rise! Rain indicates that the air is falling. Heavy rains and very dark clouds can seem pretty scary at times, but those are not areas of the storm that produce tornadoes. In fact, in most large tornadoes, the area of the storm that is producing the tornado may be fairly bright, and not look nearly as ominous as the part of the storm where the heavy rain is falling!
15. b. -- **False**... While we'd like for it to be true, radars are limited in what they can "see." Because of the curvature of the earth, and the fact that a radar beam travels in a straight line, we cannot see the bottom of storms that are more than 15 miles from the radar! If a storm is 60 miles away...we can't see anything below 2,000 feet! So the part of the storm that may produce the tornado signature is not being seen by the radar. Many small tornadoes do not produce a clear signature in time for us to be certain that a tornado may exist. And sometimes there are other factors that limit the ability of radar to accurately detect or pinpoint a tornado!
16. d. -- **All of the Above** ...If you have no basement, then you need to put as much stuff between you, and the outdoors as possible. Most people, who are killed by tornadoes, are struck by debris flying around in the air, or things that fall on top of them. So, if you go to a small room in the center of the lowest floor of your home, where the walls are close together, and there are no windows to the outdoors, you will have the maximum protection that your home can offer.
17. c. -- **Funnel Cloud**... The word twister is slang for the word tornado...so a twister is a tornado. A waterspout is simply a tornado that occurs over water. Typically a waterspout is not as strong as a tornado over land. The funnel cloud is formed by the strong circulation that may eventually become a tornado...but funnel clouds remain aloft and do not touch the ground. Once they touch the ground they become a tornado. Funnel clouds get their name from the shape of the cloud!
18. b. -- **Tornado** ...While hurricanes are much larger than tornadoes in terms of aerial coverage, tornadoes are capable of much higher winds. The maximum hurricane winds are in the vicinity of 220 miles per hour. Tornadoes max out around 318 mph. Microbursts run a distant third with top winds near 100 mph...which are about the same as the weakest tornadoes.
19. a. -- **Start!** ...We know a lot about tornadoes...but we still don't completely understand the mechanics that cause them to begin. That is why storm chasers enter the field to study tornadoes each year. They make measurements and observations that will hopefully unlock the mystery surrounding the birth of a tornado!
20. b.--**No**...There is no evidence to support the notion that cloud seeding affects tornadoes in any way. In fact there is no evidence that cloud seeding works at all!

## **Basic Storm Knowledge:**

21. c. -- **16,000,000** At any one time, hundreds of thunderstorms are occurring around the earth! And, on an annual basis, around 16 million thunderstorms form, go through their life cycle, and then dissipate.
22. a -- **1/2 inch** ...Though lightning bolts are very bright, and can be seen for miles...the actual electrical current occurs within a small column of air no wider than a dime!
23. c. -- **In your house** ...It is always best to be in a sturdy building or shelter during a lightning storm. Cars are second best, but lightning has blown the tires off of cars, and broken car glass, so the potential to be injured by lightning is slightly higher in your car, than in your home. Even in your home, you are not completely safe from lightning. It can travel through doorknobs, metal plumbing, electrical cords, and even come in through windows.
24. b. -- **You hear thunder** ...Even before you hear thunder, it is possible to be struck by lightning. But, the rule is, if you hear thunder, you are close enough to be in danger. Sometimes you can't see lightning that is occurring because it is happening inside the cloud, or your view is being blocked by buildings or other objects. So, don't wait to see it to before you take cover...it might be too late! Another high risk time for lightning to strike is when rain begins to fall as the storm approaches.
25. c. -- **Group of Trees** ...None of the answers offer a perfect option, but the group of trees is probably the best one. You should never stand under a single tree out by itself; they are usually great lightning targets. Also, never huddle in a group of people. If lightning hits one person it could spread to others. You are still at risk under a group of trees, but the risk is not as high as the other two options. In all lightning situations, you must think about what offers the best protection from objects that conduct electricity...and objects that are the tallest in the area where you are.
26. c. -- **50,000 degrees Fahrenheit** ...A lightning bolt is as hot as the surface temperature of the sun! But it is concentrated into a very narrow column of air. This rapid heating of the air causes invisible shock waves in the air which makes the sound of thunder! Since sound waves dissipate in the atmosphere after about 12 miles, there are times when you may see a bolt of lightning more than 12 miles away...but be unable to hear the sound!
27. c. -- **30,000,000 times** ...Some intense storms in Florida have been known to exhibit lightning flash rates in excess of 100 flashes per minute, so it's not hard to imagine that lightning strikes the earth over 30 million times per year in the U.S.. Worldwide, lightning makes contact with the earth about 3 billion times per year!

28. b. -- **Florida** ...The answer to the previous question holds the key to this question. The tropical nature of Florida makes it a great spawning ground for daily thunderstorms. Lightning strikes every square mile of Florida about 10 times per year on average...far more than any other state in the U.S.!
29. a. -- **100,000 miles per second** ...All the more reason to respect the dangers of lightning. You can't outrun it...and you never see the one that gets you!
30. c. -- **Soccer Balls** ...A new United States record for hail was set on June 22, 2003 near Aurora, Nebraska, when a hailstone 18 ½ inches in diameter dropped to the earth! This is about the size of a youth soccer ball! Considering that hailstones fall from the sky at over 70 miles per hour, it probably put a pretty good dent into whatever it hit!
31. b. -- **4,800 per year** ...Hailstorms are fairly common in the United States...but not every thunderstorm produces hail. Most storms that do produce hail only drop smaller varieties. It takes intense updrafts, and the right combination of wind fields inside the storm to produce large hailstones. It's uncommon to get hail much larger than golf balls unless the storm is strong enough to produce a tornado! Hail size is often a good gauge of how strong a storm might be. So if you have a thunderstorm overhead that is dropping large hail on you...go ahead and assume that it may be capable of spinning up a tornado as well, and take cover!
32. a. -- **150 mph** ...Although microbursts are formed in a different way than tornadoes, they are still quite dangerous! In fact, top microburst winds can have the same damaging effects as an EF-2 tornado! A microburst is a very strong straight-line wind produced as a rapid outflow of air from a storm that is collapsing. There can be both wet and dry microbursts. The way you can tell whether the storm produced a microburst rather than a tornado, is from the damage path. Tornadic damage occurs in swirls, while microburst damage is usually strung out in a relatively straight line or in a large arc.
33. a. -- **12 inches** ...This world record rainfall occurred very close to Kansas City... in Holt, Missouri on June 22, 1947, when Harry Truman was the President of the United States! In fact the 12 inches of rain fell in LESS than one hour, just 42 minutes to be exact! This world record still stands today!
34. c. -- **264 pounds** ...Water moving at 8 miles per hour, puts 264 pounds of force on every square foot of any object it encounters. Try taking a small board into a swimming pool and pushing it around in the water...it is not easy to do. With raging flood waters, the force of the moving current can sweep away cars, trucks, people, and anything else in the path of the flash flood! People underestimate the power of water, and that can be a deadly mistake! Never walk or drive into water that is rising rapidly or moving quickly. Also avoid murky water that makes it difficult or impossible to judge the depth of the water...that becomes a death trap for many flood victims each year.

35. b. -- **Microburst** ...Microbursts are created when air falling from the base of the cloud rushes rapidly to the ground, and spurts out in all directions at very high speeds. One way this can happen, is through the sudden collapse of the thunderstorm. When a large burst of rain drops from the cloud, the air beneath it is shoved downward rapidly. Once the air hits the ground it is forced outward in all directions rapidly!
36. c. -- Squall **Line** ...Squall lines are long lines of very strong thunderstorms. Usually there are high winds, hail, and very heavy rains accompanying these storm families.
37. a. -- **Red Sprites** ...Red Sprites are reddish in color and not visible from ground level. They last only milliseconds, and occur at altitudes between 30 and 60 miles above the ground. Lightning discharges at the top of thunderstorms temporarily change the electrical fields above the top of thunderstorms, and help create these reddish shimmers that extend to near the top of the atmosphere! Blue Colas, and Green Pibbs may be formed by mixing drink additives with certain carbonated beverages...but they have nothing to do with weather, other than providing refreshment during hot days!
38. a. -- **70 mph** ...To some extent hail size determines the terminal velocity of hailstones. Larger stones have higher velocities because they can overcome the wind, raindrops, and other hailstones they run into on the way to the ground. We have never measured the actual speed of hailstones, but estimate top speeds to be just above 70 mph!
39. a. -- **Amount of lightning** ... Research has shown that, in general, the amount of lightning is a good indicator of the severity of a storm. The total amount of lightning is considered...so that both cloud to ground, in cloud, and cloud to air strikes are considered.
40. b. -- **Hail** ...The new polarimetric radars are superior at detecting rain drop size, rainfall rates, and hail. There is no difference in the ability to detect tornadoes or lightning.
41. b. -- **Ice** ...Believe it or not, the presence of ice is an important, if not vital, ingredient in the formation of lightning. The height of the freezing level inside a cloud also has an impact on lightning formation as well. There tends to be less lightning in tropical storms because the storms are much warmer and ice is not as abundant as in storms that occur over land, and farther north.
42. a. -- **Nitrogen** ...Lightning heats and dries the air near the core of the strike, which then replaces the hydrogen molecules with nitrogen! Nitrogen, by the way, is the most abundant gas in the atmosphere, constituting about 78% of the atmosphere!

43. b. -- **Heat** kills more than any other type of weather phenomena!

### **General Meteorology/Climate:**

44. a. -- **Hydrogen** ...Hydrogen makes up about 71% of the inferno we know as the sun. Helium makes up 27%...and a few other trace element gasses round out the rest. The sun is located about 25,000 light years from the center of our galaxy...and orbits our galaxy once every 200 million years! The earth is typically closest to the sun in early January...that is called “perihelion”...at which point the earth is 91,401,587 miles from the sun. The sun and earth are farthest apart in early July. That is called “aphelion...and at that point the distance between earth and the sun is 94,513,190 miles!

45. a. -- **225 degrees Fahrenheit** ...Without an atmosphere, the earth’s temperatures would be similar to that of our moon. Overnight lows would plummet to about -240F...then rise over 400 degrees during the day, to highs around 225 degrees! The earth’s atmosphere is what makes the planet habitable by delaying the return of the sun’s heat back into outer space. This delay in the radiant heat returning to outer space, is called the “greenhouse effect”, even though the function of our atmosphere, and a greenhouse are quite different in many ways.. The planet’s heating and cooling is far more complex than the simple “trapping” of heat which occurs in a greenhouse.

46. b. -- **Water Vapor** ...Water vapor in the form of humidity, clouds, ice crystals, and super cooled water, at any one time fills only 4% of the earth’s atmosphere, yet it is responsible for at least 90% of the warming of the earth. In the troposphere where all the weather occurs, water vapor is, at times, responsible for up to 95% of the “greenhouse” warming. The amount of water vapor in the atmosphere varies quite a bit. On dry sunny days...there is far more nitrogen in the air than water vapor...and on those days when water vapor is scarcer... carbon dioxide kicks in and helps absorb the radiant energy needed to keep our planet’s temperature in balance.

47. c. -- **10 percent** ...The relationship between water vapor and carbon dioxide is very complex. The two compete for energy to absorb, and in areas where water is abundant in the atmosphere...carbon dioxide has almost no warming effect at all, because water vapor absorbs more of the infrared radiation. In the troposphere...where most of the weather occurs, CO<sub>2</sub> is only responsible for anywhere from ~4% to 8% of the warming. Additional warming is achieved in the stratosphere, where water is much less abundant than CO<sub>2</sub>. Carbon dioxide is only capable of absorbing radiation within a small spectrum. Water vapor has a far greater ability to absorb infrared radiation through a broader spectrum of visible light..., and therefore has a greater ability to create a warming effect. Contrary to popular belief, a doubling of carbon dioxide would have very little

- additional impact on the earth's temperature. A 2% increase in relative humidity in any one location, has the **same** effect as doubling the carbon dioxide!
48. b. -- **Nitrogen** ...Nitrogen accounts for about 78% of the earth's dry atmosphere! Next is oxygen at 21%, followed by Argon, which accounts for 1% of the dry atmosphere.
49. c. -- **4 percent** ...See the previous question for the breakdown...but water vapor can only occupy up to 4% of the air overhead at any one time. As concentrations of water vapor approach 4%, precipitation tends to form...which keeps the volume of water vapor stable at under 4%! This is what is called precipitation efficiency! This is a very important point, because if water vapor were to permanently increase to levels above 4%...then we could see more significant global warming ...however the planet does not work that way. That is just one of many checks and balances in the earth's atmosphere that helps keep our planet's weather stable enough for human life!
50. c. -- **97 percent** ...Actually, the correct amount is 96.6%! Again, contrary to popular belief, the earth contributes most of the carbon dioxide to the atmosphere! Humans only provide 3.4% percent of that gas to our air. Interestingly enough, not all of that small percentage comes from the burning of fossil fuels. Something as simple as plowing a farm field releases huge amounts of CO<sub>2</sub> into the air from the soil! Even tilling a garden releases CO<sub>2</sub> into the air. And of course, humans exhale carbon dioxide...so when we breathe...we put carbon dioxide back into the air!
51. a. -- **More than 70%** ... This is very important, because the oceans have incredible influence over the weather on the earth. More and more we are learning how ocean currents contribute to certain types of weather patterns. The El Nino, and La Nina events are ocean based phenomena that affect certain weather patterns, and how storms interact with those patterns. The northern hemisphere has far more land mass than the southern hemisphere. As a result, the climate of the southern hemisphere is different than that of the northern hemisphere. For example, there is less annual temperature variance from summer to winter in the southern hemisphere! Because of the abundance of water south of the equator, temperatures respond to changes in the sun angles, and the length of daylight more slowly. That is because humid air heats and cools at about half the speed of dry air! There is also less carbon dioxide in the southern hemisphere...because there is less land mass.
52. b. -- **Transfer heat from the tropics poleward** ...Hurricanes also act as a heat balance for the atmosphere. These enormous storms contain huge amounts of heat. They are considered "warm core" storms...meaning they get warmer toward the center of the hurricane...as opposed to normal non-tropical systems, that get colder toward the core. As a result, hurricanes release massive amounts of heat through the precipitation process, as they drift toward northern latitudes,

where they distribute the heat into the colder air. This heat transfer is another way the earth acts to keep our climate stable. Even though hurricanes can have a devastating impact on areas they hit...in the grand scheme of things...they do serve a purpose.

53. b. -- **False** ...Global CO2 levels have been up to 14 times higher than they are now. In fact, current levels have only been LOWER than they are now, twice in long term records of global CO2 levels.
54. c. -- **1934** ...While global temperatures registered warm temperatures during 1998, it was not as warm as 1934. The 1930s and the 1950s were hotter than the 1990s. 1998 was the warmest year of the 1990s due to a very strong El Nino which altered the earth's climate that year. There has been no significant warming of the planet since 1998, and in fact, a general trend of global cooling has been occurring since 1998.
55. c. -- **The period of time involved** ...While climate and weather are closely related, they really are two different sciences. And many people are confused, and misled by the differences.
- Weather* is considered a short term event. A snowstorm that lasts for two or three days, or a brief thunderstorm is considered weather. The ups and downs in temperatures for the next 8 or 10 days are considered weather. If you drop from 70 degrees to 2 below zero overnight, that's still weather. A change in the weather does not mean there is a change in the Earth's climate!
- Climate* deals with very long term and slowly changing weather patterns. Climate involves years and years' worth of temperature, precipitation, and other pertinent data. The earth's climate changes very slowly, and you cannot perceive a change in the climate based on differences noticed over the period of a few months, or sometimes even over the course of a year or two. We use the averages of temperatures over the course of at least 30 years to figure out what is considered a normal high or low temperature, for example. Some climatologists are dealing with thousands of years of data to determine the wild changes the earth has undergone. Because the climate is ALWAYS CHANGING, and has been for millions of years, the term "Climate Change" is really meaningless. The earth's climate has been both warmer and colder than it is today, and will continue to experience warm and cold periods in the future.
- So, while we use climate information to make weather forecasts, and climatologists use weather information to determine long term patterns, they are separate sciences!
56. b. -- **La Niña** ... While every situation is different, there seems to be a higher threat for severe storms, and tornadoes during a La Niña year. That does not mean there will be no severe weather in other patterns, but the La Niña creates a more volatile storm situation.

57. c. -- **Dropped** ... There are natural cycles in the amount of solar irradiance that reach the earth. Since 2004 we have seen a very large drop in the levels of irradiance leading an increasing number of solar scientists to believe that we are entering another prolonged solar minimum similar to one experienced about the time the United States was founded! You may recall the bitterly cold winter George Washington and his troops endured at Valley Forge...those type winters may become more frequent during periods of low solar irradiance. The Earth has been in a Grand Maximum of solar irradiance from about 1900 to the early 2000's
58. a. -- **Zero** ... This is a bit of a trick question. The ice floating in the oceans already displaces all the water that it will displace when melted. So, concerns about a huge sea level rise because of sea ice melt, is unfounded. Any rise in ocean levels would have to come from ice over land masses, and that melting is also cyclical and natural.
59. c. -- **Nobody knows** ... No one is even certain of where the proper place to measure the Earth's temperature would be. There is a huge debate over that issue right now. In addition, records of Earth's temperature retrieved from satellite data only goes back to the 1970s, so utilizing those records cannot yet give us a true baseline temperature. The bottom line is that nobody knows for certain what the average global temperature is, or should be!
60. a. -- **Increase** ... Bernoulli's Principle published in 1738 is still valid and used today in our atmospheric models. Pressure and wind speeds are inversely proportional, meaning they work in reverse...higher pressure tends to cause winds to decrease and vice versa, but there are always other forces at play that make this scientific principal just part of the equation that determines wind direction and speed.
61. c. -- **Very light** ... Near the center of a high, pressures are closer to equilibrium and the temperature differences are also less dramatic...so many of the forces that influence wind are closer to a balance. In fact, the slower the wind speeds, the less the Coriolis force (the force created by the spinning of the earth) acts on the air movement.
62. c. -- **Physics** ... We use the laws of physics to predict weather. Math, of course plays a prominent role, as do many other subjects such as geography, chemistry, and even English! But without the laws of physics to guide us, we would have no hope of applying consistent rules of logic for predicting weather!
63. b. -- **False** ... During the planet's early history, no oxygen existed in the atmosphere...it was trapped in the oceans...which actually rusted due to the oxygen content!

64. b. -- **False** ...The sun's energy fluctuates for a number of different reasons. This, along with other powerful cycles in the solar system and galaxy, has a huge influence on our planet's climate!
65. a. -- **True** ...Bacteria is the most plentiful life form on the planet! As a result, different bacteria life forms can release and absorb large volumes of gases that have an impact on the ocean and the atmosphere! So even the smallest forms of life can make a big difference!
66. c. -- **Cloudiness** ...Greater sunspot activity creates a stronger solar wind, which blows dust past the planet. A weaker solar wind allows more dust to settle onto the planet. The dust acts as a nucleus that helps water molecule to condense and to form cloud cover. So more dust equals more cloudiness...as a result, sunspots have a huge influence on the Earth's climate
67. b. -- **How much it weighs** ... Barometric pressure is just like having the air over your head step on the bathroom scales! But it takes a precise and accurate instrument to measure the small changes in weight. Barometric pressure readings are important because they help us to quantify changes in the properties of the air passing overhead, which helps us make accurate forecasts.
68. c. -- **Air is getting lighter** ...There are a number of things that make the barometer drop, which tells us that the air is become lighter. They include increasing humidity, warming of the air, or a combination of both! However, you cannot draw any conclusion about the weather ahead based solely on a dropping barometer.!
69. c. -- **Denver, Colorado** ...Denver is located at a mile above sea level, so there is less air between Denver and the top of the atmosphere. Locations at sea level have more air pressing down on them...so the weight of the atmosphere (barometric pressure) is always higher!
70. d. -- **All of the above** ...As you might guess, there are many factors that affect the flow of air in any one location around the planet. The earth rotates at a much higher speed than the air above it...but if you are standing at the equator...the earth's rotational velocity is much greater than if you were standing at the north pole...where it rotates much slower. As a result, the air over the poles moves much faster in relation to the earth below, than the air at the equator! And that's just one factor!
71. c. -- **Both** ...Powerful high or low pressure areas move a lot of air. When lows intensify, they suck air into them. Powerful outbreaks of bitterly cold air create areas of very high pressure which blow air out from the center. So, both situations can increase wind speeds.

72. b. -- **Hotter to colder air** ...As air heats, it expands and tries to push into cooler air. As it does so, the energy level of the air drops and that distributes heat more evenly, as the air tries to seek equilibrium!
73. c. -- **Air Temperature** ... The air's ability to hold moisture fluctuates with the temperature. Warmer air has more volume and therefore has the ability to hold more water vapor than colder air. The air's ability to retain moisture doubles every 20 degrees that it warms. As an example...40 degree air can hold twice the amount of moisture than 20 degree air. That's one reason that cold fronts can turn water vapor into rain...the air loses its ability to hold on to moisture in vapor form!
74. a. -- **How much moisture is in the air** ...The dew point is a much more direct measurement of the total volume of moisture in the air. The relative humidity can be 100% at 20 degrees or at 50 degrees...but there is a lot more moisture in the air at 50 degrees (see question #73). As a result, it's much easier to tell where humid air is moving and gathering based on dew point temperatures. The rule is simple: The higher the dew point temperature...the greater amount of moisture in the air. We use dew points in forecasting to determine the likelihood of severe weather, or to determine whether we'll get rain versus snow. It's an important forecasting tool!
75. b. -- **East to West** ...It's just the reverse of the northern hemisphere!
76. a. -- **Thicker than near the North Pole** ...Tropical air is very warm. Warmer air expands more than colder air...therefore the top of the tropical atmosphere is much higher in the sky, than near the North Pole! Thickness, or height of the atmosphere is another tool used in forecasting.
77. c. -- **Stratosphere** ...The stratosphere is stable and the air actually warms up with height, instead of cools with height as it does in the troposphere where most of the weather occurs! Commercial jets ascend into the stratosphere for long flights because the air is clear and stable, and there is less turbulence! It makes for a better ride!
78. c. -- **6,200 miles** ... There are various opinions on this subject. NASA uses the 76 mile mark as the outer edge of the atmosphere. But from the standpoint of meteorology, the exosphere ends around 6,200 miles high! That is where the last few atoms and molecules escape into outer space.
79. b.-- **Troposphere** ... This is the part of the atmosphere closest to the ground where we live, work and play! This is also the densest part of the atmosphere, and the only one where enough water exists to create clouds, rain and snow!
80. c.-- **5-12 miles high** ... Considering the atmosphere is 6,200 miles deep, this is a relatively thin layer of air!

81. c.-- **Cumulonimbus** ... Strong thunderstorms can penetrate the lower part of the stratosphere. Once the intense updrafts encounter the bottom of the stratosphere, the warm and stable air in the stratosphere stops the air from rising, and forces it to spread out. This is what forms the broad “anvil” cloud at the top of thunderstorms. No other clouds can form that high. There is very little moisture in the stratosphere.
82. a.-- **Ozone** ... Since the stratosphere is clear and dry, sunlight heats the air in this layer and forms ozone. Ozone absorbs ultraviolet radiation from the sun and helps to protect us from damage to our skin from the strong UV rays. Near the earth’s poles, ozone dissipates during the winter months when there is little or no sunlight. Once the sun returns to the pole, ozone redevelops. This is a natural process that creates what is known as the ozone “hole” during the winter months.
83. a.-- **4 to 12 miles high** ... the Stratosphere is lower near the poles and high near the equator.
84. c.-- **Mesosphere** ... the gases in the Mesosphere are dense enough to slow down incoming meteors. Most meteors burn up in this layer of the atmosphere.
85. a.-- **31 to 53 miles high** ... this is considered the “middle” of the atmosphere.
86. b.-- **Thermosphere** ... the top temperature in this layer can reach 6,200°F , while the coldest temperature in this layer is around -184°F! Quite a spread! Since the air this high is so thin, you would still feel cold in the 6,000° air! Weird, right?!
87. b.--**53 to 375 miles high** ... this is part of the upper atmosphere. The air becomes more dense the closer to the Earth you get, so the air at the top of the Thermosphere is very, very thin.
88. c.-- **6,200 degrees** ... this occurs in the Thermosphere. The word “thermal” means “of or relating to heat” ... so you can figure out how this layer got its name!
89. a.-- **Ionosphere** ... this layer occurs in the Thermosphere ... it is located between 37 and 190 miles high. This is where most of the incoming radiation from the sun creates electrically charged gases that easily reflect radio waves back to Earth.
90. b.-- **Auroras** ... the charged particles and gasses within the Ionosphere encounter waves of protons coming from the sun to light up the skies with the beautiful colors of the Aurora Borealis (northern hemisphere) and the Aurora Australis (southern hemisphere)
91. c. -- **Thermosphere** ... the Space Shuttle orbits between 190 and 330 miles high, located near the top of the Thermosphere.

92. a.-- **Exosphere** ... in Greek, the word “exo” means “outer.” This top layer of the atmosphere is the outer layer of the Earth’s gaseous boundary, and the point where true outer space begins!
93. a. -- **80,000 pounds (40 tons)** ... That’s on an average year. There is more during years when the sun is quieter, with fewer sunspots. There is less if the sun is active.
94. c. -- **Both** ... Aside from the sunspots (discussed above), our solar system circulates through the galaxy called the Milky Way. There are dustier areas of the Milky Way, and when the planet enters those areas, there is more dust settling onto the planet. There is a high correlation between ice ages on Earth, and times when we have been in those dustier parts of the galaxy!
95. c. -- **12,000 years** ... Give or take, it’s about that often, and it is somewhat regular, due to longer period solar cycles, our trajectory through the galaxy, positions of other planets within our solar system, and a variety of other natural cycles that are external to our planet! What happens in space...does not necessarily stay in space!
96. c. -- **Both** ... Studying the previous two questions should give you some sense of the power of nature both on and off this planet. The sun is the primary driver of our climate, but as you have learned, there are other factors happening billions of miles away that also influence our climate. Some people may believe that humanity can affect Earth’s climate, but that notion confirms their complete lack of understanding of the powerful forces over which we have no control. Obviously, we want to do what we can to prevent pollution and the waste of natural resources. But, the dubious idea that we can prevent global warming, global cooling, or even “climate change,” ignores objective, proven science.

### **Weather Trivia:**

97. a.-- **Kansas**...Kansas holds the distinction of having the most long-track tornadoes. Those are tornadoes that stay on the ground for 20 miles or more
98. a.-- **Elvis Presley**...On April 5, 1936, a devastating tornado ravaged Tupelo, Mississippi, killing over 200 residents. One of those who survived the devastation was an infant by the name of Elvis Aaron Presley.
99. c. -- **200** ... The record outbreak of tornadoes on April 27, 2011 broke the record of 128 set on April 3, 1974!
100. a. -- **1933**...The first known film of an actual tornado was made in 1933. This is nearly two decades earlier than the 1951 Corn, OK tornado film once believed to be the earliest ever taken.

101. a. -- **Oklahoma City**... Oklahoma City has been hit by over 100 tornadoes! That's more than any other city in the world. Because of its location, the key ingredients for tornado formation come together in and around that area more frequently than other areas of the country. Dry air from west Texas heats up, then moves eastward toward Oklahoma City, where it runs into moisture from the Gulf of Mexico creating what is called a "dry line. "The dry line is very efficient in creating tornadoes because it brings together a plentiful supply of very hot air...with very thick humidity.
102. b. -- **1972**...In 1972, the first organized, and government funded, chase teams from the National Severe Storms Laboratory in Norman, Oklahoma began to study tornado formation by trying to intercept tornadoes, and place weather instruments in their paths. This research has expanded and now encompasses a broad range of scientists from government, academia, and private concerns. The results have yielded better tornado warning systems, fewer tornado deaths each year, and a better understanding of how tornadoes form. By the way, the first tornado chaser ( that we know of) began doing so in the late 1940s and early 1950s...however, he was never part of an organized chase team.
103. c.-- **235 miles**...March 22, 1953 a single tornado was on the ground across parts of Louisiana and Mississippi for 235 miles.
104. a. -- **2.6 miles wide** ...On May 31,2013 in El Reno, Oklahoma. The tornado was an EF-5 and killed, among other people, a famous storm chase team. The previous record was on May 22, 2004 a tornado near Hallam, Nebraska reached 2 ½ miles wide. This was an F-4.
105. c. -- **758** ...Prior to 2011,May 2004 was the most active month for tornadoes with 542 confirmed touchdowns. But April 2011 has taken the prize for the most active tornado month in recorded history with 758!
106. a.-- **3 Feet** ... The smallest recorded tornado track was 3 feet wide!
107. c. -- **30,000 pounds** ...Train cars weighing up to 30,000 pounds have been moved or blown over by tornadoes!
108. a. -- **Floods** ... About 135 persons per year are killed in floods. Tornado deaths are now under 50, and lightning deaths are usually between 70 and 90 per year. Believe it or not, heat kills even more than floods...over 200 die in hot weather related situations every year!
109. b. -- **False** ... While you can get thunderstorms that form in air cold enough to create snow, the processes that help form tornadoes are absent. Warm air near the ground must be present to allow the tornadic wind circulation to be drawn downward from the thunderstorm to make contact with the ground.

110. a. -- **Canada** ... Tornadoes have occurred in every country of the world at one time or another, but the geography of the United States makes it number 1 in reported tornadoes, with over 1,000 per year!! Canada is a distant second with about 100 reported each year! The orientation of mountain ranges, and the way warm moist air combines with other factors essential to tornado formation are most common in the United States.
111. c. -- **134 degrees** ...Set at Greenland Ranch, California, located in Death Valley, on July 10, 1913. That's only 2 degrees cooler than the world record!
112. b. -- **121 degrees** ...Set near Alton, located in Osborn County in north central Kansas, on July 24, 1936.
113. b.-- **118 degrees** ...Set at both Warsaw, located in Benton County, and in Union, located in Franklin County, on July 14, 1954.
114. c. -- **-80 degrees** ...Set at Prospect Creek Camp, Alaska, located along the Alaska pipeline, on January 23, 1971.
115. a. -- **-40 degrees** ...Set at Lebanon, located in Smith County, Kansas, on February 13, 1905.
116. a. -- **-40 degrees** ...Set at Warsaw, Missouri, located in Benton County, on February 13, 1905. Note that Warsaw holds both the hottest and coldest records for the state! Also note that both the records for Kansas and Missouri were set on the same day!
117. b. -- **134 degrees** ... On 13 September 2012 the World Meteorological Organization disqualified the record for the highest recorded temperature, exactly 90 years after it had been established at El Azizia, Libya, with a measurement of 58 C (136.4°F). The official highest recorded temperature is now 56.7 C (134 F), which was measured on 10 July 1913 at Greenland Ranch, Death Valley, California, USA.
118. c. -- **253 mph** ...This happened on April 10, 1996, at Barrow Island Australia during Tropical Cyclone Olivia. This supplants the previous record of 231 mph set at the Mount Washington, New Hampshire Weather Observatory...one of the most inhospitable places on earth!
119. b. --**12 inches in 60 minutes** ...Believe it or not, this world record set on June 22, 1947 occurred in Holt, Missouri, just 24 miles northeast of downtown Kansas City, Missouri!
120. c. -- **-40 degrees** ...The two meet at this very cold temperature. This is because it is the temperature where air is completely evacuated of water vapor...good place to start a temperature scale!

121. a. -- **-40 Celsius** ... Does this sound familiar? At -40 the air's ability to hold water vapor is gone. What little water vapor exists as the temperature approaches -40 turns to ice crystals, and drops out of the air.
122. b. -- **Kelvin** ... The Kelvin scale is used in a lot of scientific research because it uses absolute zero as its base, and it is easier to work without negative numbers in formulas. Zero Kelvin is -273 Celsius and about -460 Fahrenheit!
123. c. -- **-40 degrees** ... Again, -40 is an important number, and clouds very high in the sky, at low pressure readings can remain in microscopic water droplet form until the cloud temperature approaches -40 ... then the cloud "glaciates".
124. b. -- **Twice as fast** ... This is very important as humid air retains heat longer than dry air. This has many implications in daily weather forecasting.
125. b. -- **No** ... As any object cools, it draws heat away from the air around it. That process continues indefinitely until the object reaches equilibrium with the air around it. The third law of thermodynamics states that no object can reach absolute zero. Theoretically if an object were to reach absolute zero, it would become a pure perfect crystal, but it is not possible.
126. a. -- **0 to 1** ... Typically, there are very few EF-5 tornadoes. Many years have none. Most have one. 2011 was highly unusual with 6 EF-5 tornadoes...and a total of 22 EF-4 and EF-5s combined! That's the 4<sup>th</sup> highest number of "maxi" tornadoes on record. The record is 36 set in 1974.
127. a. -- **78** ... This is a 30 year average based on data from 1981 to 2010
128. a. -- **39** ... This is a 30 year average based on data from 1981 to 2010
129. b. -- **2** ... This is a 30 year average based on data from 1981 to 2010
130. c. -- **3** ... This is a 30 year average based on data from 1981 to 2010
131. b. -- **56** ... This is a 30 year average based on data from 1981 to 2010
132. c. -- **1925** ... 794 deaths
133. a. -- **January 11**
134. b. -- **Missouri** ... 6 of the top 25 have been in Missouri

135. a. -- **Would cause people to panic** ... Before 1950, at various stages of development of the Weather Bureau, the use of the word "tornado" in forecasts was at times strongly discouraged and at other times forbidden, because of a fear that predicting tornadoes may cause panic. This was in an era when very little was known about tornadoes compared to today, by both scientists and the public at large. Tornadoes were, for most, dark and mysterious menaces of unfathomable power, fast-striking monsters from the sky capable of sudden and unpredictable acts of death and devastation. As the weather patterns which led to major tornado events became better documented and researched, the mystery behind predicting them began to clear--a process which still is far from complete, of course. In 1950, the Weather Bureau revoked the ban on mentioning tornadoes in forecasts. Answer Courtesy: Roger Edwards, Storm Prediction Center.
136. c. -- **36** ...EF4 tornadoes in 1974.
137. a. -- **7** ...EF5 tornadoes, also in 1974
138. c. -- **2013** ...A combination of climatic factors made 2013 a very quiet year for tornadoes with only **943** reported. Since accurate record keeping on annual tornadic activity only goes back about 60 years, we have no idea whether or not this is part of a long term climate cycle, but solar and ocean temperature proxies would suggest that it's highly likely
139. a. -- **2011** ...A combination of climatic factors made 2011 a very active year for tornadoes with 1,894 reported. Since accurate records on annual tornadic activity only go back about 60 years, there may have been higher numbers in years prior to records being kept.
140. a. -- **-128.6** ...Measured at Vostok, Antarctica in December 2013. Vostok held the previous record as well. Some new remote sensing techniques in use currently, have recently measured readings as low as -135.8 F, but since these temperatures were not taken by a standard calibrated "sanctioned" thermometer, they cannot be used for the record books. It does show that the extremes on this planet may not yet be defined.

### **Weather Observation/Earth Science:**

141. a. -- **A Cloud That Forms At Ground Level** ... There are two types of fog...advection fog where fog elsewhere spreads into your area, and radiation fog that forms due to clear skies, light wind, and high humidity near ground level.
142. c. -- **Visibility** ... On a clear day with no haze in the atmosphere, the typical visibility is between 7 and 10 miles. That can, however, vary widely based on the elevation of the weather observation point.

143. a. -- **Temperature** ...The warmer the air, the more moisture it is able to hold, regardless of available moisture. The ability to hold moisture approximately doubles with every 20 degrees of additional heat added to an air mass. For example, 70 degree air can hold about twice as much moisture as air that is only 50 degrees! This explains a lot when thinking about how condensation and precipitation forms in the atmosphere.
144. c. -- **27** ...There are 2 basic categories of clouds, stratus and cumulus, that form at different levels in the atmosphere called "etages."There are 3 etages, each with 9 cloud types that occur within each etage, for a total of 27 types of clouds. All of the clouds are variations of the basic stratus and cumulus types. There are a couple of rare cloud types that are not considered typical clouds...they are: nacreous clouds and noctilucent clouds.
145. d. -- **All of the above** ...Clouds are categorized based on appearance, the height at which they form ,and their shape. Knowing the type of clouds you can expect help us to forecast weather conditions, temperature, and precipitation. It is vital for pilots to know and understand cloud types as it can affect the operation of aircraft.
146. a. -- **Noctilucent** ...These wispy clouds are only visible during deep twilight, illuminated by the sun below the horizon. They form at altitudes of 47 to 53 miles and are most frequently observed at high latitudes.
147. b. -- **Nacreous** ...These amazing clouds have a wavy appearance with all colors of the rainbow present within the cloud, which gives them a pear-like texture. They form between 9 and 16 miles high in the atmosphere, and are usually seen after sunset or before sunrise in polar regions.
148. c. -- **Ceiling** ...Ceilings are reported for a variety of reasons, including operation of aircraft, and forecasting changes in the weather.
149. d. -- **All of the above** ...The base of the cloud layer can tell you many things about what is happening in the atmosphere above. That information is used by airports, weather forecasters, storm chasers, photographers, and other weather enthusiasts!
150. a. -- **Counter-Clockwise** ...The Earth rotates from west to east as observed from the northern hemisphere.
151. b. -- **8.3 minutes** ...That's because the light particles have to travel over 91 million miles from the Earth to your eyeball...at the speed of light: 299,792,458 meters per second!
152. a. -- **94,512,904 miles** ...Aphelion usually occurs around July 4<sup>th</sup> each year.

153. c. -- **91,403,812 miles** ...Perihelion usually occurs around January 4<sup>th</sup> each year.
154. a. -- **The position of the sun** is affected by our annual trip around the sun. The tilt of the Earth causes the sun to shift position in our skies, which affects both the angle of sunlight and the length of day in any one location. That is what causes the changes of the seasons!
155. c. -- **33%** ...Only 29% of the Earth's surface is land, and fully 1/3 of that land is desert!
156. b. -- **71%** ...Since most of the Earth's surface is covered in water, which is considered to be desert, more than 80 % of the Earth is considered a desert. Man occupies a very tiny portion of the entire planet!
157. c. -- **Sahara** ...Located in northern Africa, it covers 3.5 million square miles!
158. a. -- **Antarctica** ...The Antarctic Polar Desert covers the entirety of Antarctica and covers 5.5 million square miles!
159. a. -- **Antarctica** is the largest. Second is the Arctic Polar Desert, which covers 5.4 million square miles, covering parts of Alaska, Canada, Greenland, Iceland, Finland, Norway, Sweden, and Russia!
160. b. -- **Pacific** is the largest ocean on Earth covering 59 million square miles. All of the Earth's land mass could fit into the Pacific ocean! It contains over half of all the water on Earth, and is the oldest of the ocean basins.
161. b. -- **Pacific** is also the deepest ocean on the planet! The deepest part of the ocean is called the Challenger Deep and is located beneath the western Pacific Ocean in the southern end of the Mariana Trench, which is located several hundred miles southwest of the U.S. territorial island of Guam. Challenger Deep is approximately **36,200 feet** deep.
162. b. -- **Mount Everest** is the highest mountain as measured above sea level. The top of the mountain is 29,029 feet above sea level. There are a number of other high peaks in the Everest chain that are also among the highest in the world! It is located in the Mahalangur mountain range in **Nepal**. There are some estimates that it is as high as 29,035 feet!
163. a. -- **Mauna Kea** is the **tallest** mountain on Earth and it is located in Hawaii! It stands almost 33,500 feet tall, but 19,700 feet of the mountain is below the surface of the Pacific Ocean. If it were all above sea level, it would be almost a mile taller than Mount Everest! The Hawaiian Islands are a chain of volcanic mountains.

164. c. -- **Asia** ...Asia is the largest continent in the world out of 7 continents, situated in the eastern and northern hemispheres. Asia has an overall area of 44,579,000 sq. km. (that constitute 8.7% of the total surface area of the earth) and a population of almost 4 billion people (60% of the human population of the world).
165. a. -- **Australia** ...The continent of Australia is a single country continent. It is the sixth largest country by total area. It is also the smallest of all the seven continents. The island of Greenland, with a surface area of 836,330 square miles is considered the world's largest island, while **Australia**, at 2,941,300 square miles is deemed the smallest continent.