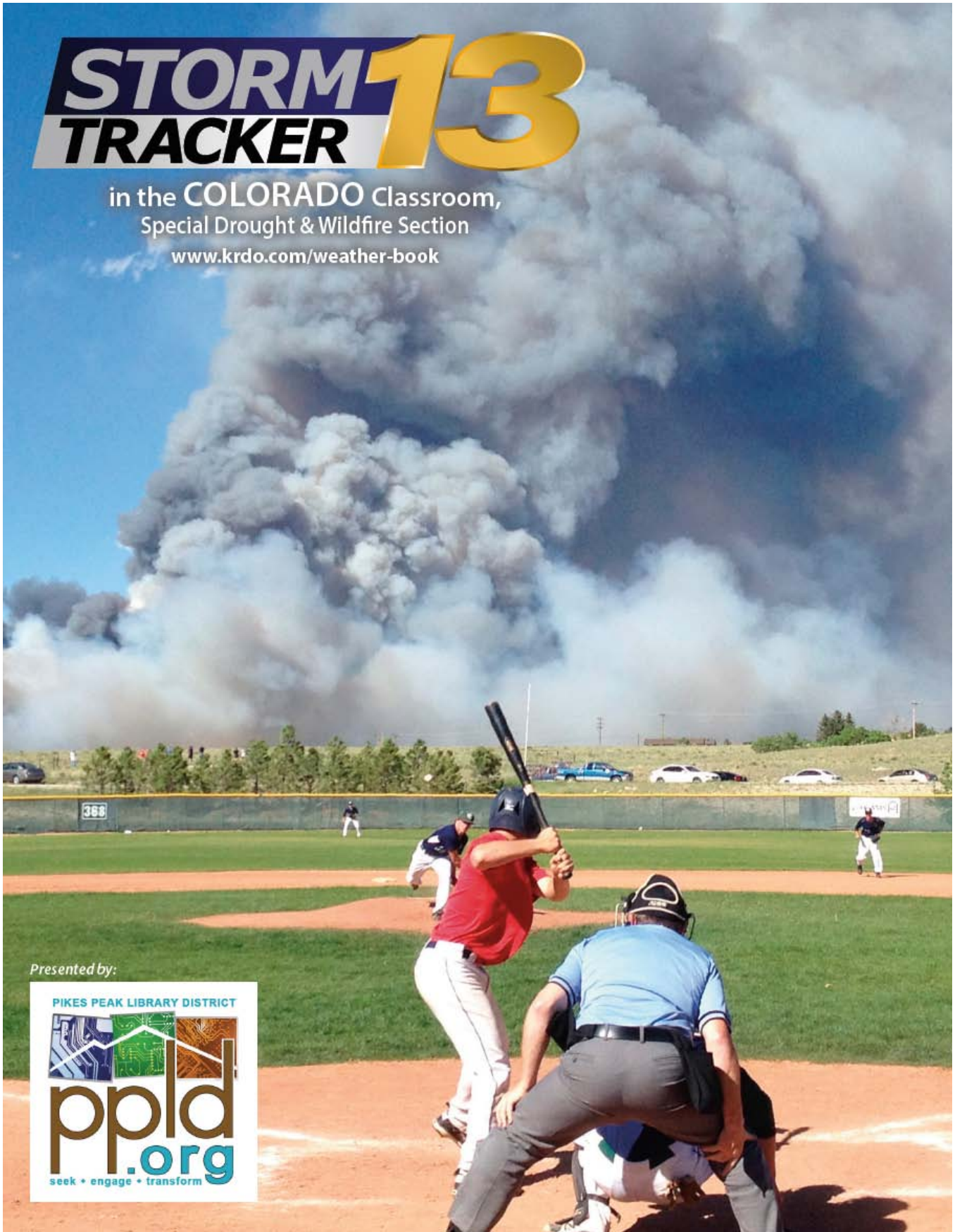


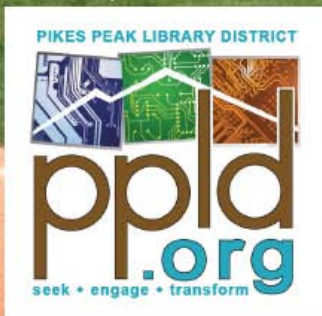
# STORM TRACKER 13

in the COLORADO Classroom,  
Special Drought & Wildfire Section

[www.krdo.com/weather-book](http://www.krdo.com/weather-book)



*Presented by:*



## ANSWER KEY



# Layers of the Atmosphere and the Water Cycle

## REVIEW

- 1 In what layer of the atmosphere do the temperatures get the warmest? THERMOSPHERE
- 2 What layer of the atmosphere is closest to the ground? TROPOSPHERE
- 3 As water evaporates from the surface and begins to lift up into cooler air, what process happens that turns that moisture into clouds?  
CONDENSATION
- 4 When water does not runoff into lakes and rivers, it soaks into the soil into what we call GROUND water.
- 5 When the clouds grow in size, they produce PRECIPITATION which brings moisture from the air back down to the ground.
- 6 In the stratosphere there is a layer of ozone, a gas that absorbs incoming solar radiation. This makes the temperature go up in the stratosphere. When you get to the mesosphere, what happens to the temperatures as you go up in height?  
THEY DROP WITH HEIGHT
- 7 In what layer does most weather occur? TROPOSPHERE
- 8 Water that is given off by trees in the water cycle is known as TRANSPIRATION
- 9 In what part of the atmosphere do most meteors burn up? MESOSPHERE



# Understanding Air Pressure

**AIR PRESSURE IS THE WEIGHT OF AIR ON AN OBJECT.** It's a measure of the weight of all the air molecules on top of something. When standing on the beach at sea level there is approximately 14.7 lbs of air sitting on top of every inch of your body. That's over 400 lbs of air just on the top of your head!

Size of your head\* is approximately 30 square inches

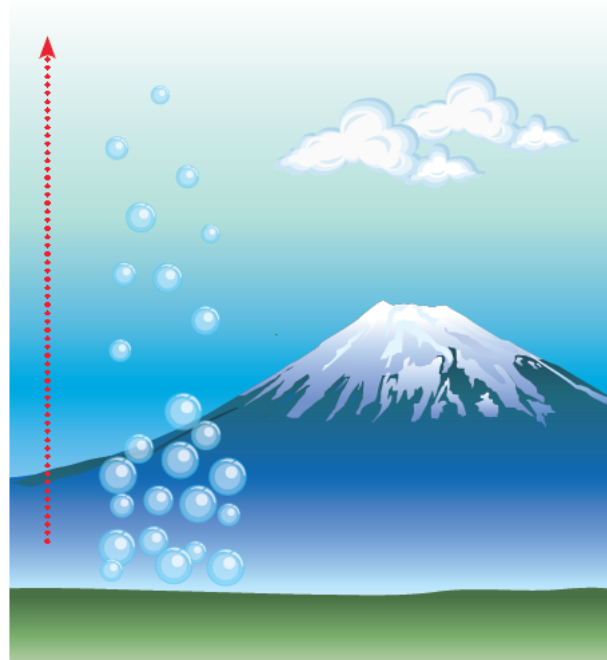
Weight of air at sea level is 14.7 lbs per square inch.

( $30 \times 14.7 = 441$  lbs on top of your head!)

Consider the clustering of air molecules near the surface of the Earth. They are pulled down by gravity. As you go up in the atmosphere, the air is thinner and fewer molecules are present.

\* Average size of a child's head at age 10.

AIR BECOMES THINNER WITH HEIGHT



- 1 If you are on top of a mountain, would the pressure of the air be heavier or lighter than on the beach? LIGHTER
- 2 Would you have more or less oxygen up in the mountains than on the beach? LESS
- 3 What causes so much air to cluster near the ground? GRAVITY



## What is Temperature?

### TEMPERATURE IS THE WAY WE MEASURE THE AMOUNT OF HEAT WE CAN FEEL.

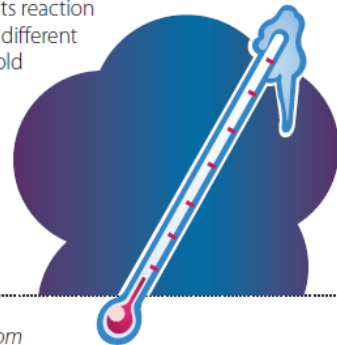
Actually, temperature is a measure of the speed of tiny particles in the air. Everything is made up of very tiny objects called molecules. These molecules move around. The hotter it is, the faster they move, and the higher the temperature. So, temperature is really just a measure of how fast these little molecules are moving around. The amazing thing is, temperature not only is a measure of how fast molecules are moving, it also relates to how we feel.

As the temperature gets colder and colder, the molecules move slower and slower. In theory, at some point the molecules stop moving altogether. It cannot get any colder than this. This temperature is known as **absolute zero**. Although the word "zero" is used, the temperature in Fahrenheit (F) is  $-459^{\circ}\text{F}$  and in Celsius is  $-273^{\circ}\text{C}$ .

### How Can You Measure Temperature?

We use a **thermometer** to measure temperature. There are several different types of thermometers: glass and mercury, digital and others that look like a dial. How can all of these measure temperature? Everything reacts to temperature changes. When it's hot outside metal and all materials expand. In contrast, when it's cold all materials will contract, or get smaller. Mercury, a liquid metal, will take up more space when it's hot than when it's cold.

So many different types of material can be used in a thermometer to measure its reaction to temperature. Since these different materials react to hot and cold air, we can measure the changes in them and figure out the temperature! That is how a thermometer works.



**EXPERIMENT:** (Note to teachers: Do not use mercury thermometers in the classroom to ensure student safety. Alcohol thermometers are readily available.)

- 1 Take an alcohol filled thermometer and look at where the level of alcohol is.
- 2 Run the thermometer under cold water ... Now where is the level of alcohol? ANSWERS WILL VARY
- 3 Where is the final level of alcohol? ANSWERS WILL VARY

Why did the alcohol move inside the tube? BECAUSE THE LIQUID CONTRACTS WHEN IT IS COOLED AND EXPANDS WHEN IT IS WARMED

What liquid other than alcohol would change its size because of the temperature? MOST LIQUIDS WILL CHANGE SIZE WITH TEMPERATURE CHANGES



## Identifying Clouds

Try to identify the following clouds by the definitions given on the previous page.  
Write your answers below each picture.



CIRRUS



CUMULUS



STRATUS



CUMULONIMBUS



CAP CLOUD



LENTICULAR



## The Sky is Falling!

**WHENEVER A CLOUD IS FULL OF DROPLETS OR ICE CRYSTALS, THEY CAN GROW TO BECOME TOO LARGE TO REMAIN IN THE CLOUD.** They start growing by sticking to a dust particle or a small piece of suspended material in the air. More and more droplets or crystals stick to it until it is too heavy to remain in the cloud and the droplet or collection of crystals begins to fall. This is called **precipitation**.

If the precipitation that falls is a large droplet (water), then it is called **rain**. Water freezes at 0°C (32°F). So, if the air in the cloud is very cold, then a large collection of ice crystals may form into a flake and fall as **snow**. There are several other types of precipitation, as well. If a raindrop falls from a warm cloud through some very cold air and it freezes, then it becomes **sleet**. Sleet is a raindrop that froze on the way down to the ground and hits the ground in the form of an ice pellet. Another type of precipitation is **freezing rain**. Freezing rain is a raindrop that is just about to freeze on the fall to the ground. It looks like rain, but coats everything it hits in ice. It can form an icy glaze on roads, cars, trees, etc. When the droplets are smaller and supercooled, we get freezing drizzle. While the amounts of **freezing drizzle** are usually light, the impact can be serious when surfaces are coated in ice.



### REVIEW

Now that you know so much about rain, sleet, freezing rain, and snow...see if you can answer the following questions:

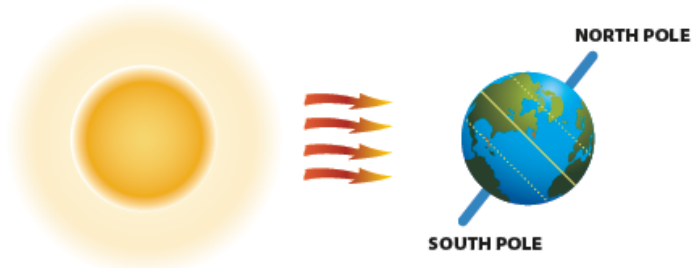
- 1 What season would you most likely find freezing rain, sleet and snow? WINTER
- 2 If a snowflake fell and melted on the way to the ground, what type of precipitation would it be? RAIN
- 3 What if that snowflake melted on the way down, but then re-froze just before hitting the ground.  
What type of precipitation is that? SLEET
- 4 Can you have rain and snow falling at the same time? YES

**BONUS** Why or why not? SINCE RAIN IS OFTEN MELTED SNOW, YOU COULD HAVE SOME OF THE SNOW ALREADY MELTED INTO RAIN AND SOME THAT HAS NOT ENTIRELY MELTED AT THE SAME TIME.



Use the previous pages on the seasons to answer the following questions:

- 1 What would the season be on April 20th? SPRING
- 2 On the first day of which season is the sun directly overhead the Northern Hemisphere? SUMMER
- 3 In which season would you expect to see the most sleet? WINTER
- 4 What season are the days the longest? SUMMER
- 5 Complete the following picture by shading the side of Earth that would be dark. From this drawing, figure out which season it is.



What season is it in the picture above? WINTER

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# Measuring Humidity

How you can measure the dew point.

## MATERIALS

- a thin metal cup or a drinking glass (*not thermal*)
- thermometer
- ice water
- a large dropper  
(*a measuring cup with a pour spout will do*)

## LESSON

### What happened?

As you added colder water to the warm water in the cup, the temperature of the water in the cup kept dropping. The sides of the cup got colder as the water inside got colder. The cup also chilled the air right next to it! When the temperature of the metal cup reached the dew point... The air just next to the cup was cooled to the dew point as well and water began to condense from the air and stick to the cup!

## DIRECTIONS

- 1** Outside on a warm, humid day in the spring or summer, put a couple of inches of warm (about 75°F) water in a cup.
- 2** Measure the temperature of the water. Now add a few drops of ice cold water to your cup.
- 3** While you are adding water, keep stirring and measuring the temperature of the water.
- 4** Repeat this procedure by adding a small amount of cold water to the cup until you see a thin film of water form on the outside of the cup.
- 5** Make a note of the temperature of the water as soon as you see the water vapor form on the outside of the cup.

*The temperature you measured is the DEW POINT!*

## REVIEW

- 1** What was the temperature of the water when you started your experiment?  
ANSWERS WILL VARY
- 2** What was the temperature of the water when you saw the condensation form on the outside of the cup?  
ANSWERS WILL VARY
- 3** Would your cup of water have to be colder or warmer to reach the dew point if the air outside is very dry?  
COLDER





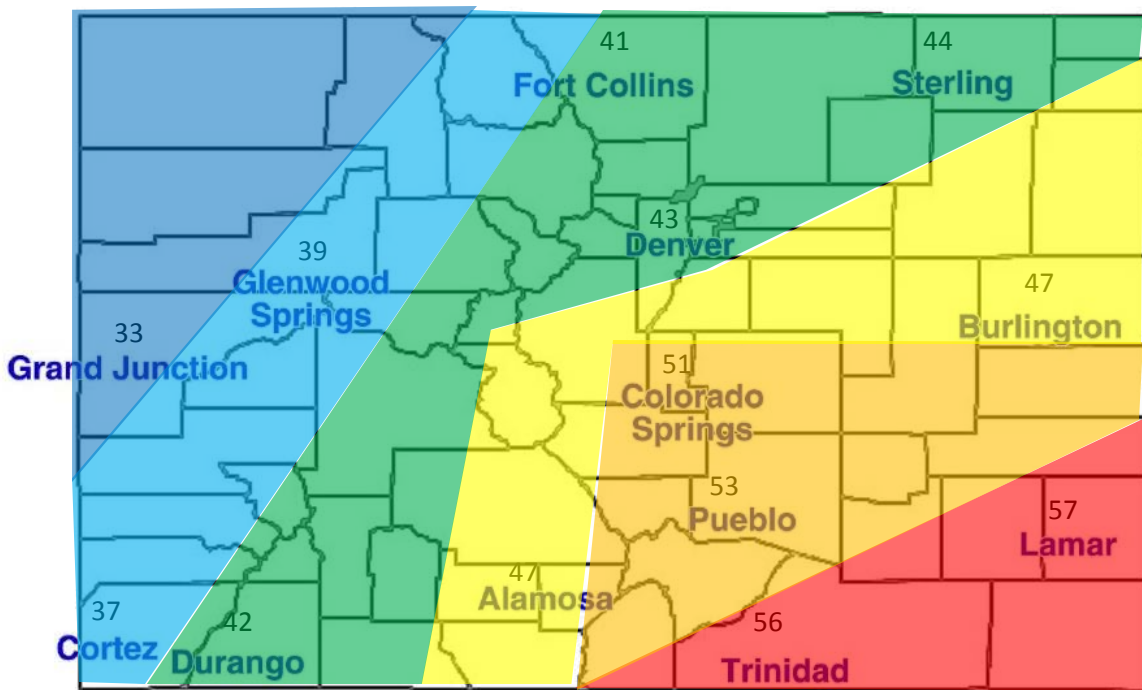
## Question Sheet

After recording weather conditions for the week, look over the weather data you collected and answer the following questions:

- 1 What time of day did you notice the coolest temperatures?  
a. Morning      b. Midday      c. Afternoon
- 2 What time of day did you notice the highest temperatures?  
a. Morning      b. Midday      c. Afternoon
- 3 What time of day did you notice the lowest relative humidity?  
a. Morning      b. Midday      c. Afternoon
- 4 What time of day did you notice the highest relative humidity?  
a. Morning      b. Midday      c. Afternoon
- 5 If there was any precipitation during the week, what happened to the humidity during that time?  
Why do you think the humidity changed the way that it did? EVAPORATION OF PRECIP. MADE THE AIR MORE HUMID
- 6 What was the strongest wind speed you recorded during the week? ANSWERS WILL VARY  
What was the weather during the time you recorded that wind speed? ANSWERS WILL VARY
- 7 Did you notice a pattern with the air pressure during the times you recorded it? Was it going up?  
Was the air pressure dropping? ANSWERS WILL VARY
- 8 Did a change of wind direction occur during the week? If so, what were the temperatures like the day before the wind shifted? What about the day after the wind shifted? ANSWERS WILL VARY
- 9 Did clouds affect the temperatures for the week? (Were sunny days warmer than cloudy days?  
Were cloudy days warmer than sunny days?) ANSWERS WILL VARY
- 10 What did you notice about the overall weather pattern for the week that lead to so many different types of weather to occur? ANSWERS WILL VARY



## Mapping the Weather Area Map



# Making a Barometer

Barometers are used to measure air pressure. Use the following directions to make your own barometer and measure changes in the air pressure.

## MATERIALS

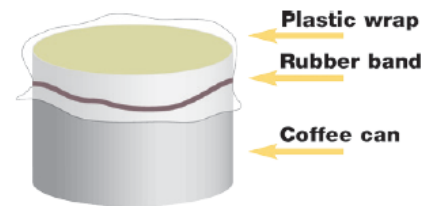
- small coffee can
- plastic wrap
- rubber band
- drinking straw
- large index card

## LESSON

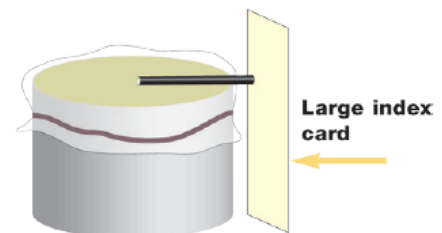
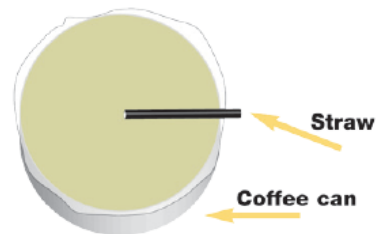
Notice that when the air pressure is high, it pushes down on the plastic wrap and the straw is tilted up. When the air pressure is low, the plastic wrap lifts upward and the straw points down.

## DIRECTIONS

- 1 Take a small coffee can and cover it tightly with plastic wrap. Secure the plastic wrap with a rubber band around the can as shown above.
- 2 Tape a straw to the top of your plastic wrap cover with one end of the straw in the middle of the can's cover and the other end slightly off the edge of the can. (see right)
- 3 Next place the can beside a large index card. Use this card to mark and label where the straw is pointing on the card. Remember to write down the day and time beside each mark you make. Notice the changes on the position of the straw during each day of the week.



Looking down at the can:



## REVIEW

After recording your air pressure results for the week, answer the following questions:

- 1 What days had the highest pressure? ANSWERS WILL VARY
- 2 What days had the lowest pressure? ANSWERS WILL VARY
- 3 Why did the plastic wrap get pushed down by high pressure? BECAUSE THE OUTSIDE PRESSURE WAS HIGHER AND PUSHED DOWN ON THE WRAP
- 4 What interesting weather happened when the pressure was changing? THE WINDS WERE INCREASED; THE OVERALL WEATHER WAS IN A STATE OF CHANGE, ETC.



# The Invisible Tornado

**NOT ALL TORNADOES CAN BE SEEN CLEARLY.** Some take place at night in the dark. Some are disguised by heavy rain. Most aren't disguised by heavy rain, but even in the middle of the day you can't see them! These are invisible tornadoes.

So how do you know if a tornado is there? Remember that the definition of a tornado is a rotating column of air that connects a thunderstorm to the ground. A funnel is a rotating column of air underneath a thunderstorm that doesn't make it all the way to the earth's surface. Typically, funnels will contain actual cloud in them and will be called a funnel cloud. Sometimes the rotating column of air is touching the ground even though the funnel cloud itself doesn't appear to be. A **debris cloud** of swirling dust and dirt on the ground, indicate that a tornado has formed. If you see a debris cloud - but no visible tornado - you have just spotted the invisible tornado. These are just as dangerous as any other tornado!

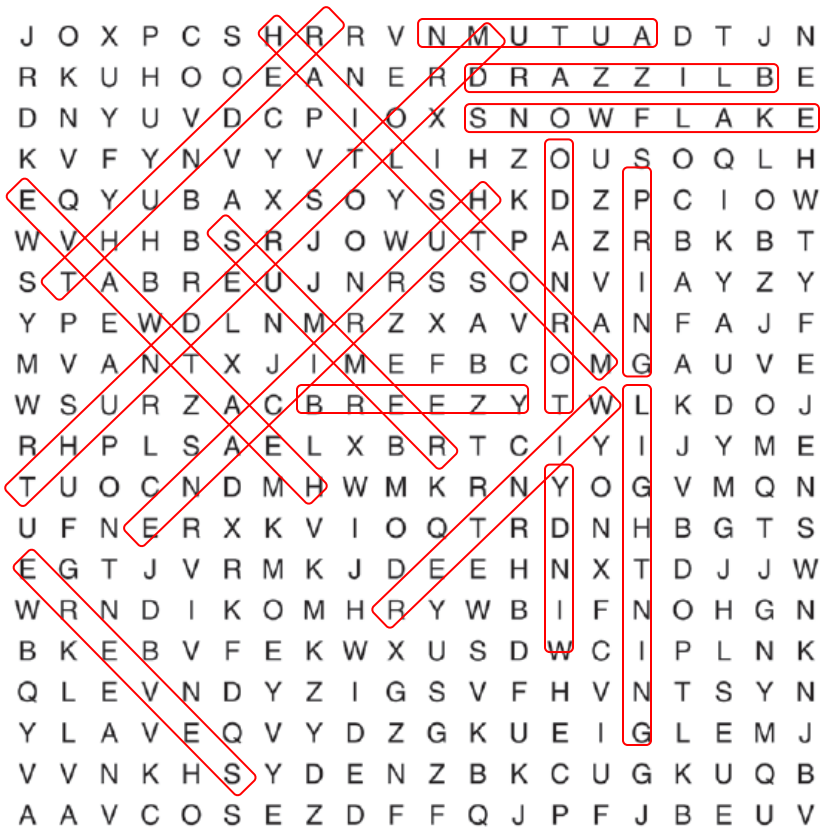
## REVIEW

Use your knowledge of tornadoes to answer the following questions to the best of your ability.

- 1 About how many tornadoes occur in the United States every year? ABOUT 1,000 (MORE RECENTLY AROUND 1,200)
- 2 According to the National Weather Service, Colorado averages around 22 tornadoes per year. In which season of the year do you think most of these tornadoes occur? ALL SEASONS, BUT SPRING/SUMMER IS THE PEAK
- 3 If a framed house was hit by a tornado and the damage consisted of a roof that was torn off, windows were blown out, but most of the walls were still standing, then what would the Fujita-scale ranking be of this tornado? (use the chart on the previous page for assistance on this one) EF-2 TORNADO
- 4 What type of cloud rotates at the bottom of a thunderstorm and is a warning sign of a possible tornado? WALL CLOUD
- 5 What is the name of the cloud of dust and broken materials that forms at the bottom of a tornado? DEBRIS CLOUD
- 6 A tornado looks like it is developing from a thunderstorm. What would the name of this developing tornado be BEFORE it reaches to the ground? FUNNEL CLOUD



# Weather Word Search



- |           |           |           |              |
|-----------|-----------|-----------|--------------|
| AUTUMN    | HEATWAVE  | SNOWFLAKE | THUNDERSTORM |
| BLIZZARD  | HURRICANE | SPRING    | TORNADO      |
| BREEZY    | LIGHTNING | SUMMER    | WINDY        |
| HAILSTORM | SEVERE    | THUNDER   | WINTER       |



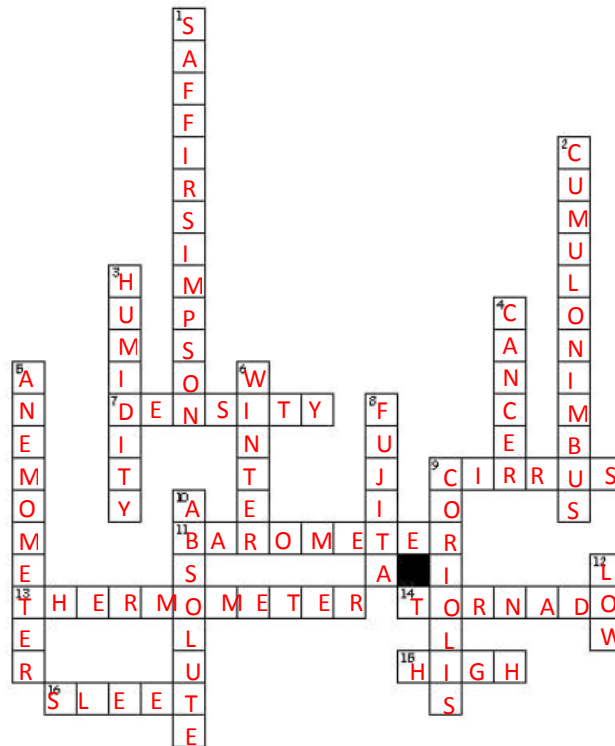
# Meteorology Crossword

## ACROSS

7. The measure of how much mass (weight) is in a given volume.
9. A high, thin cloud made up of ice crystals.
11. Used to measure air pressure.
13. Used to measure air temperature.
14. This is violently rotating column of air.
15. The wind flows clockwise around an area of \_\_\_\_\_ pressure.
16. Frozen drops of rain that fall as pellets of ice in winter.

## DOWN

1. The scale by which we categorize hurricanes.
2. A type of cloud that is associated with thunderstorms.
3. A measure of how much moisture is in the air.
4. The sun is directly overhead the Tropic of \_\_\_\_\_ on the summer solstice.
5. Used to measure wind speed.
6. The sun is directly overhead the Tropic of Capricorn on the \_\_\_\_\_ solstice.
8. The scale by which we rank tornadoes.
9. This is an apparent force on the wind that is caused by the spin of the Earth.
10. When all molecules stop moving, you have reached the coldest possible temperature called \_\_\_\_\_ zero.
12. The wind flows counter-clockwise around an area of \_\_\_\_\_ pressure.





## Watches & Warnings

**THE NATIONAL WEATHER SERVICE, ALONG WITH LOCAL TELEVISION STATIONS, USE A SYSTEM OF WATCHES AND WARNINGS TO KEEP YOU ADVISED DURING SEVERE WEATHER.** Read over the following definitions of the watches and warnings and try to answer the questions below.

**SEVERE THUNDERSTORM WATCH** –

This means that conditions are favorable for severe thunderstorms to develop (usually issued for a large number of counties).

**SEVERE THUNDERSTORM WARNING** – This means that a severe thunderstorm has been detected for a specific area (usually issued for one or two counties).

**TORNADO WATCH** – This means that conditions are favorable for storms to develop that could produce a tornado (usually issued for a large number of counties).

**TORNADO WARNING** – This means that a tornado has been either detected on radar or sighted (usually issued for one or two counties).

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### QUESTIONS ABOUT WEATHER SAFETY

- Which is more serious?    a) Tornado Watch    **b) Tornado Warning**
- During a tornado warning, the best place to take shelter is:  
a) your garage    b) a large room with plenty of windows    **c) basement or storm shelter.**
- It is safe to go outdoors during a Severe Thunderstorm Warning.    True or **False**
- At what point should you take shelter from a tornado?  
**a) When a Tornado Warning is issued**    b) When a Tornado Watch is issued  
c) When a Severe Thunderstorm Watch is issued    d) Never
- A severe thunderstorm is detected on radar moving toward your county. Which of the following would be issued?  
**a) Tornado Warning**    b) Tornado Watch  
**c) Severe Thunderstorm Warning**    d) Severe Thunderstorm Watch
- There is plenty of time to move away when lightning begins to strike.    True or **False**.
- Hailstones are falling very fast and can hurt you if you don't take shelter inside.    **True** or False.