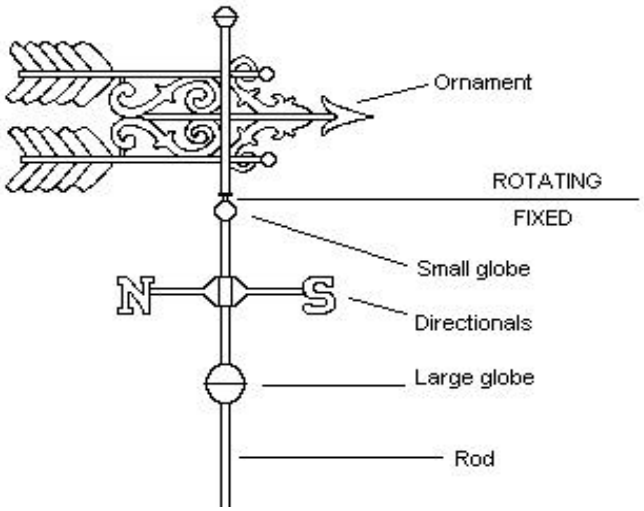
Weather Vane

A weather vane is a tool used to tell which direction the wind is coming from (if the weather vane is pointing to the west, then the wind is blowing from the west). Weather vanes are usually found on top of buildings so they will catch an open breeze -- look for them on the top of barns, houses, and weather stations.

Weather Vanes have two basic parts: a rotating part (called the "ornament") and a fixed part. There are two basic rules that must be followed when designing a weather vane:

1) The ornament must have unequal area on either side of center (that is, it must be larger on one side than the other).
2) The ornament must have equal mass on either side of center (that is, it must be balanced).

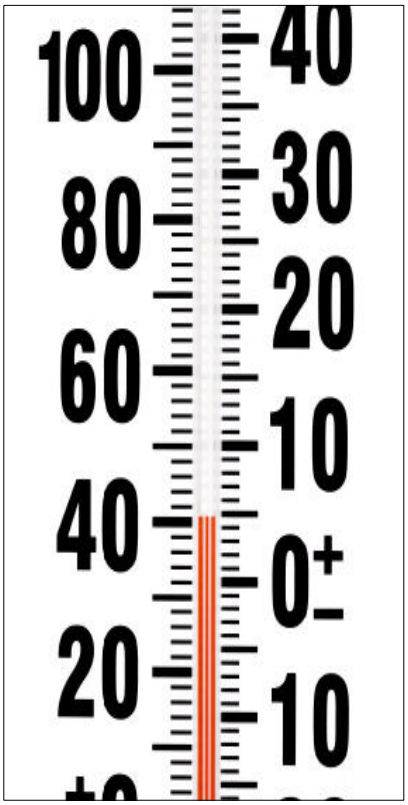


The part of the vane that turns into the wind is usually shaped like an arrow. The other end is wide so it will catch the smallest breeze. The breeze turns the arrow until it catches both sides of the wide end equally.

For additional decoration, sometimes a metal rooster or other animal sits on top of the weather vane. Also, most weather vanes have directional strips underneath the arrow to make it easier to read.

The weather vane should be installed in an area open to the wind (follow the installation instructions that comes with the weather vane). Use a compass to align the "directionals" (i.e. to make sure the "N" is pointing north, etc.).

Thermometer



A **thermometer** is a device that measures the temperature of things. The name is made up of two smaller words: "thermo" means heat and "meter" means to measure.

When you look at a regular bulb thermometer, you'll see a thin red or silver line that grows goes up when it's hotter and goes down when it's colder. This liquid is sometimes colored alcohol but can also be a metallic liquid called mercury. Both mercury and alcohol grow bigger when heated and smaller when cooled. Inside the glass tube of a thermometer, the liquid has no place to go but up when the temperature is hot and down when the temperature is cold. Numbers are placed alongside the glass tube that mark the temperature when the line is at that point.

History

One of the earliest inventors of a thermometer was probably Galileo. We know him more for his studies about the solar system and his "revolutionary" theory (back then) that the earth and planets rotated around the sun. Galileo is said to have used a device called a "thermoscope" around 1600 - that's over 400 years ago!!

The thermometers we use today are different than the ones Galileo may have used. There is usually a bulb at the base of the thermometer with a long glass tube stretching out the top. Early thermometers used water, but because water freezes there was no way to measure temperatures less than the freezing point of water.

A thermometer measures temperatures in Fahrenheit, Celsius or another scale called Kelvin. Fahrenheit is used mostly in the United States, and most of the rest of the world uses Celsius. Kelvin is used by scientists.

Fahrenheit is named after the German physicist Gabriel D. Fahrenheit who developed his scale in 1724. Ice freezes at 32 degrees Fahrenheit (F for short), and water boils at 212 degrees F. He arbitrarily decided that the difference between the freezing point and boiling point of water should be 180 degrees.

The **Celsius** scale is named after Anders Celsius (the scale used to be called the "centigrade" -- which means "divided into 100 degrees"). Anders Celsius developed his scale in 1742. He started with the freezing point of water and said that was 0 degrees Celsius (C for short). At the point where water boils, he marked that at 100 degrees C. This scale is much more scientific because the measurement is broken down into an even 100 degrees (similar to the scientific system of measuring distance and weight called the metric system).

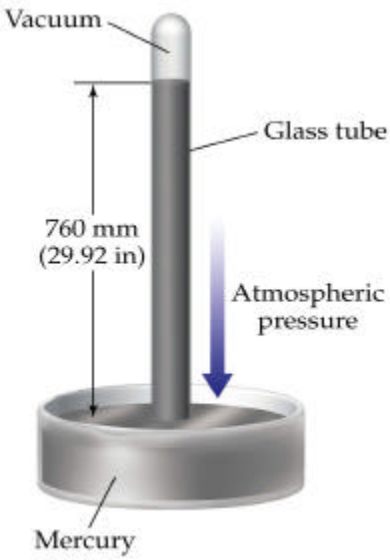
Kelvin is named after Lord Kelvin, whose full name is Sir William Thomson, Baron Kelvin of Largs, Lord Kelvin of Scotland. His scale starts at 0 degrees Kelvin, which is called absolute temperature. The Kelvin Scale (developed in 1848) measures the coldest temperature there can be. Kelvin said there was no upper limit of how hot things can get, but there was a limit as to how cold things can get. Absolute Zero is at minus 273.15 degrees Celsius (or -523.67 F) -- occurring when no heat energy remains in a substance. Absolute zero is the point at which molecules do not move (relative to the rest of the body). As far as scientists know, nothing in the universe can get that cold!

Barometer

One indispensable tool of weather forecasters is the barometer -- an instrument for measuring atmospheric pressure. Barometers come in two basic types:

Mercury Barometers

Mercury barometers haven't changed much since their invention in 1643. A column of mercury is inside a glass tube sealed at one end. The other end rests in a small cup of mercury, called a cistern. Starting from an average day, the phenomenon works like this:



Initial Reading: the barometer shows the mercury level at 29 inches, which is about average pressure for barometers at sea level.

Storm Comes In: storms are low-pressure systems. As they come into an area, there is less atmospheric pressure on the cistern. The barometer in turn shows the mercury column is falling.

Storm Goes Out: as the storm passes, the atmosphere is replaced with a calmer high-pressure system. Since the air is heavier, the barometer goes back up.

These old-fashioned barometers are fun and educational, but must be used safely (mercury is toxic and must be handled with care).

Aneroid Barometers

Aneroid, meaning "without liquid", accurately describes how this type of barometer functions. Instead of mercury, these barometers use a small metal box called an aneroid cell. This cell is actually a bellows and springs system which expands or contracts as air pressure changes. This style is also known as an "analog barometer".

Pressure readings are made on a dial, similar to the one shown at the right.

The Same, Just Different

Although mercury and aneroid barometers work on the same principles, they do so in different ways. Mercury barometers are relatively simple (though accurate) devices. Aneroid barometers employ a complex mechanism to record minute changes in air pressure.

All-Weather Rain Gauge

Operation:

The top funnel catches the rain and delivers it to the measuring tube. The measuring tube has a capacity of 1.00 inch. Rainfalls of less than one inch can be read directly from the measuring tube. Stand the measuring tube on a level surface. Read the amount to the nearest 100th of an inch. Record the rainfall in your log and discard the rain water.

If rainfall exceeds one inch, the excess flows into the outer cylinder. To measure, empty the measuring tube containing the first 1.00 inch, place the funnel into the measuring tube, then carefully pour in the excess rain water until the outer cylinder is empty. Record the measured amount in your log (don't forget to add the amounts together). It is a good idea to measure precipitation from heavy rains twice to insure accuracy. Just use an empty can or pail to receive the measured rain water, and measure again.

In cold weather, use only the outer cylinder to catch hail, sleet or snow. Melt the snow indoors. Then, using the measuring tube, measure the water content of the snow. You may also use the outer cylinder to get a measure of the water content of accumulated snow by pressing the cylinder into a level area then melting the captured snow (you can add a known amount of hot water to speed up the melting process, just remember to subtract it from the recorded amount).

Daily Log:

Whenever possible, take your readings at the same time each day. Record your readings on the daily weather log. Use the date on which you take the reading even though much or all of the rain may have fallen the preceding day, after you took your previous daily reading. Enter your reading in hundredths of an inch (0.01, 0.31, 1.01, etc.). If rainfall is less than 0.01 enter "T" (for Trace) in the daily log.

Daily Log Forms can be downloaded and printed at:
www.scoutingpages.org/us/mo/pack30 (select the Outdoor Classroom Link)

Care:

The All-Weather Rain Gauge is a precision weather instrument. With minimal care it should provide years of satisfactory service. Guard against extremely rough usage. Wash periodically with mild soap or detergent and warm water, using a household bottle brush. Do not use solvents or abrasives to clean the gauge and do not wash the gauge in a dishwasher. Do not allow accumulated water to freeze in the gauge.

Installation:

Mount the gauge on a post (ideally a 4" x 4" post). Where possible do not mount near buildings or trees that would prevent rainfall from reaching the gauge. The gauge should be mounted so that the top of the gauge is level and is about 6" higher than the top of the post.

Rain Gauge Daily Log

Name _____ C.B.S. Time _____ Section _____ Range _____ Year _____

Address _____ County _____ Township _____

	Jan	Feb	Mar	Apr	May	June	Remarks -- Severe Weather -- Storm Damage
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							
31							
Total							

Instructions

1. Try to record precipitation each day at the same time.
2. Record precipitation to the nearest 1/100 of an inch (0.01, 0.31. 1.31, etc.)
3. If precipitation is less than 0.01", record "T" (for Trace).
4. Use the remarks column to list any unusual or severe weather (example: Jan. 2 - Blizzard, roads blocked for two days).

Form available at: www.scoutingpages.org/us/mo/pack30 (select the Outdoor Classroom Link)

Rain Gauge Daily Log

Name _____ C.B.S. Time _____ Section _____ Range _____ Year _____

Address _____ County _____ Township _____

	July	Aug	Sept	Oct	Nov	Dec	Remarks -- Severe Weather -- Storm Damage
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
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20							
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							
31							
Total							

Instructions

1. Try to record precipitation each day at the same time.
2. Record precipitation to the nearest 1/100 of an inch (0.01, 0.31. 1.31, etc.)
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Daily Weather Observer's Record - Instructions

Date **Jan 6, 2007** Day of Week **Wednesday** Observation Time **5:00 PM**

Temperature (F)			Precipitation
24 Hrs. ending at Observation		AT OBSN.	Draw a straight line (——) through hours precipitation was observed, and a waved line (~~~) through hours precipitation probably occurred but was not observed.
MAX.	MIN.		A.M. 1 2 3 4 5 6 7 8 9 10 11 Noon 1 2 3 4 5 6 7 8 9 10 11 12 P.M.
36	**28**	**30**	

Precipitation 24 Hr. Amounts AT OBSN.		Snow, Ice Pellets, Hail, Ice on ground at Obsn. (Inches)	Weather Mark "X" for all types that occur during the						Remarks and Notes
Rain, Melted Snow, etc. (Inches & Hundredths)	Snow, Ice Pellets, Hail (Inches & Tenths)		Fog	Ice Pellets	Glaze	Thunder	Hail	Damaging Wind	
0.95	**8.0**	**5**						**X**	**Some drifting of snow.**

Taking and Recording Observations

1. HOW TO USE THE WEATHER OBSERVER'S FORM: One form section should be used for each day's observation and the date should be entered in the heading. Data should be promptly and carefully entered on the form; the form may then be kept as your permanent record.

2. OBSERVATION TIME: Observations should be taken at the same time each day throughout the year, and this time should be entered on the form. The preferred times are between 5 pm and 8 pm. Take only one observation per day.

3. SUBSTITUTE OBSERVERS: In order to gather accurate records over a period of time, it is important to arrange for another person to take observations in case you are not able to. People often ask a member of the family or a friend or neighbor.

4. MAXIMUM & MINIMUM TEMPERATURE OBSERVATIONS: If the thermometer you are using is capable of recording the maximum and minimum temperature, record the values on the form (if not, enter "N/A" in the spaces on the form). Reset the maximum and minimum setting on the thermometer after recording the values (follow the instructions for the thermometer).

5. RECORDING THE TEMPERATURE: Enter the temperature at the time of observation in the proper space, to the nearest whole degree. If the temperature is below zero, don't forget to place a minus sign in front of the reading.

6. PRECIPITATION (TIMES OF BEGINNING & ENDING): Beginnings and Endings should always be entered on the calendar date on which they actually occur. Show the hours during which precipitation fell by drawing a solid horizontal line through the hour columns for the period of actual observed occurrence. If the beginning and endings were not observed, draw a waved line through the hours of probable occurrence.

7. PRECIPITATION (24-HOUR TOTAL, ENDING AT OBSERVATION): Record in the space headed "Rain, Melted Snow, etc." the total depth of rain or the water resulting from melted hail, ice pellets or snow for the preceding 24 hours, regardless of whether it fell on the day of observation or after observation time on the preceding day. The amount should always be entered on the date of measurement. Every entry of measurable precipitation should be recorded to two decimal places (0.05, 0.50, 1.50, etc.). When no precipitation falls during the 24-hour observation period, a "0" (zero) should be entered so there will be no doubt as to whether any precipitation fell.

8. MEASURING LIQUID PRECIPITATION: Refer to the Rain Gauge instructions for the proper way to measure liquid precipitation. The amount should be entered on the date of measurement. The measuring tube should be emptied after the measurement has been noted.

Daily Weather Observer's Record - Instructions

9. MEASURING FROZEN PRECIPITATION: Refer to the Rain Gauge instructions for the proper way to melt and measure frozen precipitation captured in the rain gauge. This water equivalent should be entered in the "Rain, Melted Snow, etc." column. If it is thought that the gauge has caught only a portion of the fall, it will provide a more accurate measurement to discard the questionable amount in the gauge and then proceed as follows: Select a place where the new fall is as little disturbed as possible, cut out a section by sinking the inverted overflow can through the frozen precipitation and cover the mouth by slipping a sheet of thin board under it. Be careful to include only the precipitation that fell during the preceding 24 hours. This section should then be melted and measured to obtain the water equivalent.

10. NEW SNOWFALL, ICE PELLETS, OR HAIL (24-HOUR FALL): Measure the depth of new snow, ice pellets, or hail which has fallen during the preceding 24 hours only. Separate falls which melt during the 24 hour period are to be added together. Enter the total amount in inches and tenths in the space headed "24-Hr. Amounts, Snow, Ice Pellets, Hail". Where drifing occurs, measurements should be made at several points where drifing is least and the average of these should be entered. If frozen precipitation melts as it falls, enter the amount as "T" (for Trace) with a note "Melted as it fell". If the total unmelted fall measures less than half the distance from the end of the measuring stick to the first etched mark the amount should be entered as "T" (Trace). If there is an entry in the space there should also be an entry in the same date in the "Rain, Melted Snow, etc." space to show the water equivalent.

11. TOTAL SNOW, ICE PELLETS, HAIL, ICE (DEPTH ON GROUND AT OBSERVATION): The average depth remaining on the ground at time of observation in the vicinity of the station should be entered to the nearest inch (no decimals or fractions to be used) in the space headed "Snow, Ice Pellets, Hail, Ice on ground at Obsn." This measurement should be made by taking the average of the depths at three or more places least affected by drifting. This depth includes any new fall accumulated on top of older snow, ice pellets, ice, or hail. An entry should be made each day in this space as long as snow, ice pellets or ice remains on the ground. As soon as the covering has melted, enter "0" for one day (then leave blank after that). Enter "T" (Trace) for less than one-half inch.

12. WEATHER: Under "Weather" enter an "X" in the proper space for each type or types that occur during the calendar day (midnight to midnight). A brief explanation of the six types:

Fog --	Minute water droplets suspended in the air.
Ice Pellets --	Transparent, hard pellets of ice. Temperature is usually below freezing when ice pellets occur.
Glaze --	Freezing rain or freezing drizzle. Rain or drizzle that falls in liquid form but freezes to the expanded surfaces of the ground, or to unheated objects, forming a smooth coating of ice.
Thunder --	Thunder heard at the station, whether or not rain fell.
Hail --	Ice balls which usually fall during thunderstorms, when the temperature is considerably above freezing.
Damaging Winds --	Winds resulting in damage to vegetation, buildings or other property.

13. REMARKS & NOTES: Under "Remarks and Notes", write a brief report of any unusual weather conditions, giving times and dates. Damage due to weather should also be noted.

Daily Weather Observer's Record

Date ____________ Day of Week ____________________ Observation Time ____________

Temperature (F)		
24 Hrs. ending at Observation		AT OBSN.
MAX.	MIN.	

Precipitation

Draw a straight line (——) through hours precipitation was observed, and a waved line (~~) through hours precipitation probably occurred but was not observed.

A.M. 1	2	3	4	5	6	7	8	9	10	11	Noon	P.M. 1	2	3	4	5	6	7	8	9	10	11	12

Precipitation 24 Hr. Amounts AT OBSN.		Snow, Ice Pellets, Hail, Ice on ground at Obsn. (Inches)
Rain, Melted Snow, etc. (Inches & Hundredths)	Snow, Ice Pellets, Hail (Inches & Tenths)	

Weather Mark "X" for all types that occur during the					
Fog	Ice Pellets	Glaze	Thunder	Hail	Damaging Wind

Remarks and Notes

Date ____________ Day of Week ____________________ Observation Time ____________

Temperature (F)		
24 Hrs. ending at Observation		AT OBSN.
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Remarks and Notes