Community **Co**llaborative **Ra**in, **H**ail and **S**now Network

www.cocorahs.org

AN OBSERVER'S GUIDE TO MEASURING AND REPORTING PRECIPITATION DATA

OTHER RESOURCES

Additional Training Information

Check the FAQ/Help page on the CoCoRaHS web site
http://www.cocorahs.org/Content.aspx?page=Help

Illinois CoCoRaHS Forum

www.ilcocorahsforum.org

An online gathering place where Illinois CoCoRaHS volunteers can ask questions, exchange ideas, or chat about the weather.

Illinois CoCoRaHS Monthly Newsletter Archive

https://mail.prairienet.org/pipermail/cocorahs-il/

A monthly electronic newsletter sent to all Illinois CoCoRaHS volunteers. Our monthly newsletters include observation tips and other useful information that you may want to refer to in the future. Past issues can be found in this archive.

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Contact Information

My Station No: IL-	Station Name:

	Name	Email	Phone No.
County Coordinator			
Regional Coord.			

Part 1. Measuring Rainfall

Equipment

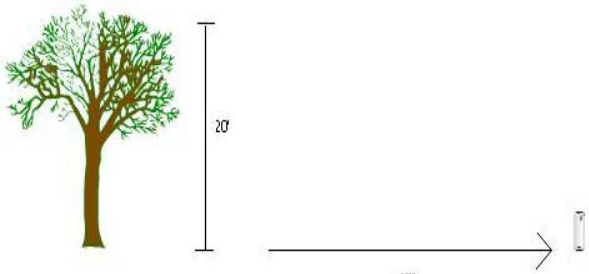
Each volunteer participating in CoCoRaHS is required to use:

- A clear plastic 4 inch rain gauge and mounting bracket

Locating and Installing the Equipment

Rain Gauge:
When installing the gauge it is important to consider its location carefully. The gauge should be placed in an area that is protected from strong winds, but is not affected by obstacles that could either block precipitation from reaching the gauge or could cause the precipitation to splash into the gauge. For example, an ideal location would be a small open meadow, surrounded by forest, or an open back yard not too close to buildings or trees. The gauge should be installed 2-5 feet (2 feet in wide-open areas, 5 feet in most residential settings) above the ground and mounted on the side of a post. The mounting post should have a rounded, pointed, or slanted top to avoid upward splash towards the gauge. The gauge should be installed at a reasonable distance away from obstacles like buildings or trees. As a rule of thumb, if a tree is 40 ft. tall, the gauge should be placed at least 80 ft. downwind from it. In developed areas, strive to locate your rain gauge at a distance from trees, etc. equal to the height of the tallest object. This will help avoid potential blockage of the gauge. It is not always possible to find the perfect location. If in doubt, do your best!

Things to remember when mounting your rain gauge



The gauge should be twice as far away from an object as that object is tall. In this picture, the tree is 20 feet tall, so the gauge is 40 feet away.

- Avoid large obstacles that could block precipitation
- Avoid mounting the rain gauge where sprinklers or other sources of artificial precipitation could affect the gauge.
- Make sure the top of the rain gauge is level. If you must mount it on a fence, a picket fence will provide the least interference. Be sure the top of the gauge extends above the fence.
- Mount the rain gauge so that heavy rain cannot splash into the gauge.
- Mount the rain gauge in an area protected from strong wind, if possible.
- In residential areas, the perfect location may be nearly impossible to find, so do your best.

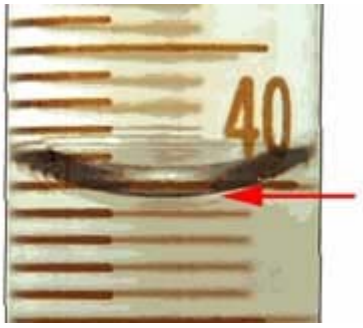
How to Read Your Rain Gauge

It is important to be as accurate as possible when reading your gauge. Scientists, engineers, and other professionals may use your data. The rain gauge is composed of four parts: a funnel, a measuring tube, an overflow tube (or cylinder) and a mounting bracket. The funnel directs the precipitation into the measuring tube and magnifies it by a factor of 10. This allows observers to report rainfall to the nearest 0.01" (one hundredth of an inch). The measuring tube, when full, will hold one inch of actual rainfall. When it rains more than one inch, the excess water will collect in the overflow tube.

Reading the rain gauge is a very easy thing to do, but it also easy to make a simple mistake. Here are several situations that could come up with your rain gauge, and how you should deal with these situations.

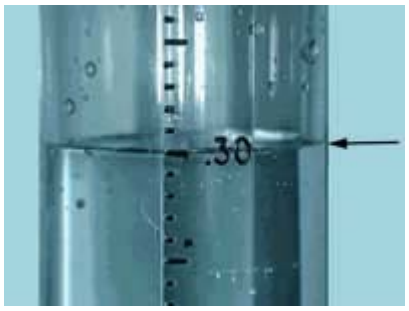
1. The surface of the water in the gauge looks curved! How do I know the right way to read it?

As water fills up the measuring tube, a curved surface may form, which is called a ***meniscus.*** The meniscus is formed by the surface tension of a liquid in contact with the sides of the tube. **Always** read the bottom of the meniscus when you take your measurement.



2. What do the numbers mean on the side of the tube, and how do I know the right way to read them?

The measuring tube is designed to magnify the rain water. This allows for more precise readings. Remember that when the tube is full, it will hold one inch of water. The measuring tube is divided, marked, and labeled in smaller increments of tenths and hundredths. Imagine that gauge is equivalent to the dollar, but instead of having one paper dollar, you have ten dimes or one hundred pennies. The smallest line on the tube would be equal to one penny. We would write in our checkbooks that we have 0.01 dollars, and when you record rainfall you would write 0.01 inches, which means one hundredth of an inch. The longer lines on the tube would be like a dime. We record a dime in our checkbook as 0.10 dollars. When recording rainfall that has reached this line, we would record it in the same way, 0.10 inches, which is one tenth of an inch. One tenth of an inch could also be referred to as ten hundredths of an inch.



In this picture, we see an illustration of the calibrated measurement tube in the rain gauge that contains three tenths (thirty hundredths) of an inch (0.30 inches)

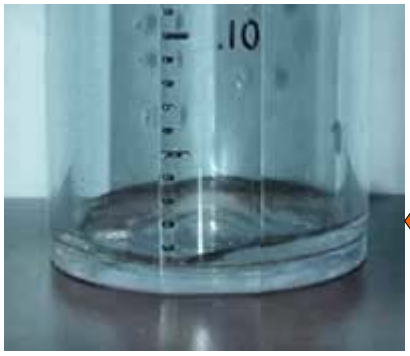
The most common error that observers make is to confuse tenths and hundredths. If you are careful, you can avoid this mistake.

3. What if there is a measurement on the middle line, between 0.30 and 0.40?

This would be equivalent to saying that you have three dimes and five pennies. You would record this measurement as 0.35 inches of rain (thirty-five hundredths). There are nine smaller lines (hundredth marks) between each large line (tenths marks). This means that you will never have a measurement like 0.599 inches, for this measurement should be recorded as 0.60 inches. Always remember that the greatest number of decimal places you can have is two. Please **do not** use a household ruler to measure the tube. A normal ruler is not calibrated like the tube and will not give accurate measurements.

4. I know that some rain fell, but there is nothing (or just a tiny bit that is below the 0.01 line) in my gauge. What do I report?

We call this a trace of rain. This should be reported as "**T"** in your reports. Even if a few drops fall that don't even dampen the gauge, you should still report a trace.



There is only a small amount in this gauge, less than 0.01 inches. This is called a **TRACE** and is reported as **"T"**

5. What if there is no precipitation to report?

Record 0.00 inches. This is especially on days when there are scattered thunderstorms in the area. It is just as important to know where it **did not** rain as it is to know how much it rained where it did.

6. What do I do if the inside measuring tube is full?

We can determine that more than one inch of rain has fallen by simply observing that the inside measuring tube is full and the additional water has spilled out into the larger overflow cylinder. Remember that the measuring tube will only hold one inch of water. Follow these two steps when measuring rainfall greater than one inch.

Step 1. You will first need to read the precipitation in the measuring tube, record it, and empty the water in the measuring tube. ***Do not empty out the water that has collected in the larger cylinder.***

Step 2. You will need to carefully pour the remaining water from the larger cylinder into the measuring tube, record it, and add up the totals. If more than 2.00 inches of rain has fallen, you will have to repeat this step several times. The easiest way of doing this is by pouring the water into the measuring tube a little bit at a time. You do not have to fill the tube all the way to the one inch mark each time. Rather, fill the tube half or three-quarters of the way, record it, and add up the totals. ***Be careful not to spill any of the precipitation.*** When in doubt, place a bucket or other large container under the gauge as you pour, so that you can collect the water if you do happen to spill. Make sure you write down each rainfall quantity and add up the total. If you don't write it down immediately, you could forget.

7. Do I report dew that has collected in my rain gauge?

On damp, dewy spring and summer mornings, it is possible that a few drops of moisture could collect in your rain gauge. It is very important that you **do not** report this as precipitation. If the only precipitation in your gauge is from dew or fog, report **0.00**. You may add a remark about the dew if you would like.

8. Should I keep a written record of my precipitation data?

It is very helpful to keep a written record of your data. This gives you a permanent record and gives us a backup in case we have computer problems. This is also important if we find that your data has been entered incorrectly into the website. It might happen that someone spots an erroneous report for your station. If so, someone could contact you to discuss it with you. Keep your written records handy. Please do not be offended, we are simply trying to keep the best quality data we possibly can.

9. What if I leave for the weekend or vacation, and when I come back there is precipitation in the gauge?

If you are gone for a few days and return to find precipitation in your gauge, please report this amount, but report it as an accumulated total. This is done using a "**Multi Day Precip Report"**. Specify the period of days the moisture accumulated. This is very helpful to us. If you think that you know approximately when it fell, make a note of it.

Part 2. Reporting Hail

Reporting of hail is optional, but is strongly encouraged. On the CoCoRaHS website, one of the reporting options is for **Hail Report**. This report form will allow for detailed information to be input to the CoCoRaHS system regarding hail that has fallen. These reports will be transmitted to the CoCoRaHS website, but just as with intense rainfall, these reports may not reach the meteorologists at the National Weather Service in time to issue severe thunderstorm warnings.

If you are observing hail of penny size or larger, please first report this by telephone to the National Weather Service, or law enforcement/emergency managers, and ask them to relay the report to the National Weather Service. Contact your coordinator for the NWS number to call.

Just remember that when you are observing a hail storm, **observe the hail storm from a safe and secure location.** Do not expose yourself to dangerous hail stones. Your safety is more important to us then collecting data. Wait until the storm is over if you deem it to be unsafe!

> Although the hail reporting page has many entries for hail, you need only report the information that you know, just leave the rest blank.

Here is a table of hail size compared to common objects.

Pea		1/4”
Mothball		1/2”
Penny/Dime	S	3/4”
Nickel	E	7/8”
Quarter	V	1”
Half Dollar	E	1 ¼”
Ping Pong Ball	R	1 ½”
Golf Ball	E	1 ¾”
Tennis Ball		2 ½”
Baseball		2 ¾”
Grapefruit		4”
Softball		4 ½”

Part 3. Measuring Snow

Snow related measurements that need to be taken in the winter time include:

1. Water equivalent of the melted new snow
2. Depth of New Snow
3. Total Depth of all Snow on Ground at Observation Time
4. Snow Water Equivalent (SWE) Core (optional)

Equipment

The 4" diameter rain gauges that we use for CoCoRaHS can be used for measuring the water content of snow. However, **you must remove the inner measuring cylinder and funnel** for measurements of snow water content and other freezing/frozen precip. The inner tube can easily crack and break if moisture collects and then freezes. But keep the funnel and measurement tube handy indoors — you'll need it. Some observers have found that having a spare outer cylinder enables them to quickly swap out gauges which is useful if it's snowing at observation time.

Have a ruler or yardstick ready (ideally one that measures in inches & tenths).

You should have a snow board (a flat board, **painted white**, ideally about 16" x 16"). They come in very handy for measuring snowfall. You will need to identify a good representative location that is as flat and level as possible where snow accumulates uniformly and does not melt prematurely. Wooden decks are OK, but they should be at least 20-30 feet away from your house since your house will affect snow accumulation patterns.

You may need to have warm water handy.

Measuring Precipitation - The Water Content of Snow

The snow (and all precipitation) will collect in the 4" diameter outer cylinder (overflow cylinder). If snow collects on the rim of the gauge you have to decide what belongs in or out of the gauge. Just take a book, clipboard, or flat object and push gently straight down on the top of the gauge. Whatever falls in is in, and whatever falls out is out. It may not be perfect, but at least it's objective. With wet snows, a lot of snow can collect on the rim, so it makes a difference.

Bring the gauge inside at your time of observation. If it has stopped snowing, you can bring it in earlier and just let the snow melt. But you may need to hasten the process. In order to measure the water content of snow with this type of gauge, **you will need to melt the contents and pour them back into the calibrated inner cylinder**.

Take the inner calibrated cylinder and pour warm water into it and jot down the amount. Then add that warm water to the outer cylinder so that all the snow melts. Pour the water back into the inner tube and record the total amount.

For example, let’s say you add 0.51" of warm water to the snow. When you measure the total sample, it reads 0.82" How much precipitation did you get? The answer should be 0.31"

0.82" - Total of melted snow with the added warm water
-0.51" - Total warm water added to melt snow

0.31" - Daily Precipitation
(the amount you should report)

Make sure you avoid spilling. It can happen.

When you're done, put the outer cylinder back outside, clean and dry, so it's ready to collect the next snow. During heavy snow (6" or greater) the cylinder may fill to the top and overflow with snow. You will have to measure more often than once daily under heavy snow conditions.

Measuring Snowfall—New Snow Amount

Snowfall is the maximum accumulation of fresh snow during the past day prior to melting or settling. We measure snowfall to the nearest 0.1 (one-tenth) inch. Maybe you have a ruler in tenths like me, but many don't. Since snow melts and settles, you may have to measure during or soon after snow ends in order to capture how much accumulated. If you wait, there may be less by the time you take your observation the next morning.

An Example

Snow begins to fall at 10:00 a.m., accumulates to 4.2" by 3:00 p.m. and then stops. The snow begins melting and settling such that by your observation the next morning you only have 2.6" of snow on your snow board. The correct number to report for your 24-hour snowfall (new snow depth) is 4.2" -- the accumulation prior to melting and settling. If the ground was bare prior to this snow your snow depth (total depth of snow on the ground) would be rounded to the nearest half inch and would be reported as 2.5 inches.

The trick in measuring snow consistently is simply finding a good place to measure and a firm surface (such as a snow board) for your ruler to set on. Some people use low picnic tables, some use their car. Sidewalks are not recommended since they tend to accelerate melting. Grass is where snow accumulates first, and it is OK to measure on grassy surfaces, but please know that the snow tends to sit up on top of the blades of grass, sometimes by one to three inches. Your ruler, on the other hand, will go right down through the snow and grass to the ground and give you an exaggerated reading. Just be careful to measure to the bottom of the snow not to the ground.

Measuring new snow accumulation is easy when the snow falls without wind and isn't melting on the ground. But when the wind blows, measuring snow becomes a real challenge. We deal with drifted snow by simply taking many measurements from a variety of locations and averaging them to get a representative measure. You will get the hang of this -- with experience.

Below is a table for converting snow depth measurements from fractions of an inch to tenths of an inch if you do not have a ruler marked in tenths of an inch.

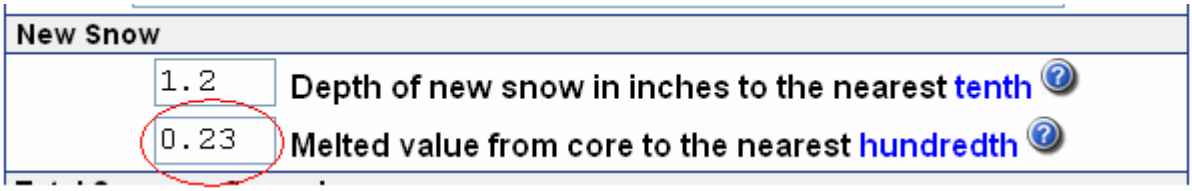
Fractions of an Inch	Tenths of an Inch
1/16 to 1/8	0.1
3/16	0.2
¼ to 5/16	0.3
3/8 to 7/16	0.4
1/2	0.5
5/8	0.6
11/16	0.7
3/4 to 13/16	0.8
7/8	0.9

Snow Depth—Total Depth of Snow on the Ground

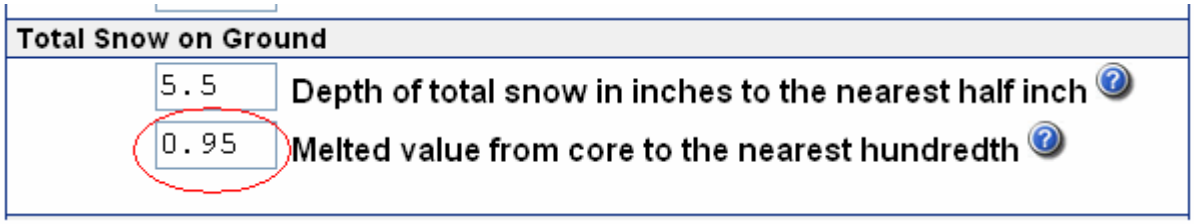
Snow depth is simply the total depth of snow on ground at your scheduled observation time (hopefully 7:00 a.m. or close). Snow depth is measured to the nearest half inch. It includes both new and old snow, and should be reported even on days when no new snow has fallen. If necessary, take an average of several measurements. For example, if half the ground has 2" of old snow and the other half of the ground is already bare, the average snowdepth would be 1".

Snow Cores—Core Precipitation

Snow Core of New Snowfall
Under some circumstances (primarily strong winds), your 4" diameter gauge will not catch all of the snow that has fallen. You can watch windblown snow crystals curve around a rain gauge like water going around a rock in a river. If you believe your gauge has not adequately caught the precipitation that has fallen (or, if you're just curious), then take a core sample of the fresh snow that has fallen. After first measuring the water content in the gauge, then take the 4" outer cylinder and "cut a biscuit" in the fresh snow by pushing it straight down. It is best to do this on your snowboard (after you've measured the snow depth, but before you have cleared the snow and put it back on the surface). Use a thin sturdy cookie sheet or something like that to slide under the cylinder so that you can lift it up without spilling the contents. Be sure to measure in a representative location -- not in a drift or in a wind-blown or melted area. Then proceed to melt and measure the water content like you would with any other measurement. Enter this value in the box provided on the data entry page as shown below.



Snow Core of Total Snow on Ground at Observation Time
Another optional but very important measurement is a snow core taken from the existing snowpack. To do this, find a spot in your yard that represents the total snow depth measurement that you recorded. Then, as in the instructions for taking a core of new snowfall, take the 4" outer cylinder and "cut a biscuit" in the total accumulated snow by pushing it straight down. Use a thin sturdy cookie sheet or something similar to slide under the cylinder so that you can lift it up without spilling the contents. Be sure to measure in a representative location -- not in a drift or in a wind-blown or melted area. Then proceed to melt and measure the water content like you would with any other measurement. Enter this value (along with snow depth) in the box provided on the data entry page as shown below.



Special Situations

Windy Conditions

Windy conditions may create a situation where the amount of snow in the raingage is not representative of what fell on the ground. In this case, we need to take a "core sample" from the snowboard or an area representative of the average new snow depth. *Note that we do not ever measure the depth of the snow in the rain gauge. Any frozen precipitation in the rain gauge must first be melted, and then measured.*

Taking a Snow Core of New Snow

- Use your snow board or other hard surface
- Take core after you have measured snow depth, but before you have cleared the board or surface of snow
- For example, if you determined the total depth of the new snow is 4 inches, then take your core sample from an area where the depth of new snow is 4 inches.
- Capture a core by inverting the outer cylinder and pushing straight down into the snow
- Use something thin and sturdy to slide under the cylinder of thin metal (aluminum flashing, spatula, snow swatter)
- Melt and measure
- If you feel this is more representative of what actually fell, then report this as your Daily Precipitation and make a note in the Comments. Include the melted amount from the snow that actually fell in the gage in your comments

Snow melts as it falls and never accumulates

- Report the precipitation in your gauge (melted) as the Daily Precipitation
- Report a Trace of new snow
- In your comments write "Snow melted as it fell"

Snow or sleet is mixed with rain and doesn't actually accumulate on the ground

- Report the precipitation in your gauge (melted) as the Daily Precipitation
- Report a Trace of new snow
- Make a note as above in your comments such as “Snow and sleet was mixed with rain but melted as it fell.”

Snow and rain are mixed and there is snow that accumulates

- Report the precipitation in your gauge (melted) as the Daily Precipitation
- Report the maximum accumulation of the new snow as your new snowfall
  - If possible, it is best to measure the depth of the new snow as soon as possible after it ends before it has a chance to melt
- Make a note that you had mixed precipitation in your comments.

Miscellaneous

- New snowfall of less than a tenth of an inch is reported as a Trace. This could be a few flurries, or a very light dusting of snow. Snow does not have to end up in the raingage!
- In some situations you might have measurable snow of a couple of tenths, but the snow in the raingage only melts down to a Trace. This can happen when the snow is very dry and/or it is windy.

How do I measure freezing rain?

“Freezing rain” is rain that falls in liquid form but freezes on contact with a surface.

Do NOT report freezing rain as "Snow". Melt and measure the moisture that has accumulated **inside** your gauge and report that as your daily precipitation amount.

Report ZERO for your new snow amount (assuming that it all fell as rain, and no sleet or snow fell or accumulated).

Part 4. Reporting Your Precipitation Data to CoCoRaHS

It is important to the CoCoRaHS network that you promptly and accurately report the precipitation data that you have collected. CoCoRaHS scientists, sponsors, and collaborators are most interested in **daily rainfall data** and **daily snow reports**. These reports will be mapped, displayed, and promptly put into use. In addition, reports of intense rainfall are extremely helpful in determining locations of potential flooding. Hail reports help the NWS severe weather warning program. Your data will be used by professionals in the fields of science, agriculture, public safety, and water resource management, to name a few. **Your data is important!**

When do I report my readings?

You are encouraged to watch your gauge anytime that it is raining. However, to stay consistent in collecting the data, you are encouraged to take daily measurements of 24-hour total precipitation and report the data as close to 7:00 AM as possible each morning. 7:00 AM has been chosen because it is usually not raining at this time in the summer months and most people are still at home. We understand that 7:00 AM will not always be possible for you, and it just won't work for everyone. But the closer we are to having everyone report at the same time, the more consistent our maps and analyses will be. This becomes especially important if it is raining at the time that you report the data. Always record the time when you did take your measurement so we know for sure.

Reporting "Intense Precipitation"

During events with heavy rainfall, "Intense Precipitation" reports can be submitted as part of the precipitation data. The "Intense Precipitation" report data are used informally in projecting potential flooding in an area. Intense rain, for the purpose of this project, is defined by a rainfall rate of at least 1.00 inch of rain or more in an hour, or snow at the rate of at least 0.5 inch per hour. However, we encourage you to report intense precipitation any time you believe the rain or snow is falling hard enough to create problems. Please know that reports entered into the CoCoRaHS website may not reach the National Weather Service in time to help them issue flash flood warnings. So if dangerous flooding conditions are occurring, please first report them to the local National Weather Service office or law enforcement or emergency managers. Contact your coordinator for the NWS number to call. *Note that Intense Precipitation reports are supplemental and you will still need to report your Daily Precipitation at the next observation time.*

Transmitting your reports

The primary method of transmitting reports will be done through the internet directly into the CoCoRaHS computer system. To report data, follow the instructions given on the CoCoRaHS website, **www.cocorahs.org**. When you reach the CoCoRaHS website, first log in. Then run your mouse cursor over **My Data** in the top bar, and then a drop down menu will appear. Move your cursor over **Enter My Data** and select the type of report you wish to enter. Then follow the instructions and fill out the appropriate data form. When you are done, check your entry for accuracy and then click **"Submit".** Your report will immediately go to CoCoRaHS and it will appear in the data reports. Data will also appear on rain or hail maps, which are updated hourly.

Editing Your Reports 

At any time, you can go back and correct any previous entry for any of the reports. Log in to CoCoRaHS as usual, then click **My Data** on the top of the CoCoRaHS web page. Then, select

List/Edit My Reports. Once your reports are listed on the screen, click on the pencil icon for the report you want to edit. Make your changes or additions, then click **Submit**.

Part 5. Station Maintenance

Please keep your rain gauge in working order by performing some simple maintenance from time to time. During warm weather dirt and sometimes algae will accumulate in the bottom of the inner cylinder. To clean your gauge, use a soft bottle brush and mild detergent. You can also tightly roll a sheet of newspaper, add some water to the inner tube, and use the rolled-up newspaper to clean the tube.

Do not let water ever freeze in the inner measuring tube. This will cause the plastic to crack. During the summer, make sure that water from sprinkler systems does not enter your gauge. If you have any maintenance questions, please contact your local CoCoRaHS coordinator.

Questions?

If you have any questions or problems, please contact your local CoCoRaHS coordinator. His or her name will be provided to you when you join the project network.

CoCoRaHS is a science education and community-based research opportunity originally developed by the Colorado Climate Center at the Colorado State University. The project is now enjoying a nationwide expansion, and we have dedicated observers like you to thank for our great successes so far. We thank you for participating in the network, and look forward to many years of learning about the fascinating patterns of rain, hail, and snowfall with you!