

## **But Why: A Podcast For Curious Kids**

What's With The Weather?

December 9, 2016

[Girl1] Why do we have clouds in our sky?

[Girl2] Well, that's a very tricky question. Clouds are made of water vapor. Water vapor is...

[Jane] This is But Why: A Podcast For Curious Kids from Vermont Public Radio. I'm Jane Lindholm.

Each episode we take your questions and we help find interesting people to answer them. You can ask a question too. We'll tell you how at the end of the episode.

Here in Vermont, we just had a coating of fresh white snow and many of you are getting out and making snow angels, maybe some snow man, maybe even doing a little bit of shoveling. But we know some of you, like our friends in South America, and Australia, and Africa, are actually enjoying summer right now.

Whatever your climate and whatever your weather, it's something you clearly have questions about, judging by how many you've been sending us. So we are going to talk all about weather today and we turn to our favorite meteorologist. That's a person who studies and predicts weather.

[Mark] Hi Mark Breen, and I'm a meteorologist at the Fairbanks Museum in St. Johnsbury, Vermont.

[Jane] If you've ever listened to Vermont Public Radio, it's Mark who you hear with the weather forecasts most mornings. He's also written a book for kids about weather forecasting. And it was his love of snow as a kid that got him interested in weather.

[Mark] I loved snow. And so I couldn't wait to find out how much snow we were going to get and that eventually led me to doing a Boy Scout merit badge on weather which got me watching the weather every day and I just kept doing it all the way till today.

[Jane] We thought Mark would be a good person to take on your weather questions. And we're going to tackle a lot of them today. So stay tuned. We're going to start with the basics.

[Kid] My name is Benjamin. I'm four years old. I live in Enfield, New Hampshire. My questions is what makes our weather.

[Mark] Our weather is made of I guess two things. You've got the air and it gets hot and it gets cold and it moves around. And you've also got moisture and that makes the clouds, it makes the rain and the snow. So that's kind of the combination. And so we've got the sun that warms us up during the day and of course it cools off at night. And as the year gets warmer or colder it starts moving around. We call that wind but it also tends to move some of the moisture around some of those big oceans and big lakes the water goes from there up and makes clouds. And if there's a lot of moisture we can get a lot of rain or a lot of snow. So a lot of it depends on how much sun we get and what time of year it is.

[Riley] My name is Riley. I am six years old. I live in Pelham, New York. How do the seasons change?

[Mark] Well Riley, the seasons change and you might notice this that every year we kind of have the same pattern, that in the winter we have all of that cold weather around, and maybe some snow, and then it warms up and melts. In the summer time we have warm sunshine maybe even a thunderstorm. Those changes happen because we get different amounts of sun during different times of the year. In the winter we don't get a lot of sun. We have short days and long nights and that's what makes it colder in the summertime. We get long days and short nights and that gets us warmer. The reason for the change is because when the earth goes around the sun, the earth is, well, not straight up and down we're actually tipped on a little bit of an angle. So in the wintertime when we're tipped away from the sun we get less sun. In the summertime, we're tipped a little bit toward the sun and that's when we get more sunshine.

[Jane] And then depending on where you are in terms of how close you are to the equator that also has something to do with what kind of temperatures you might be seeing in the wintertime because some places have very warm winters.

[Mark] That's right. The days are not all that short as you go down to the south. And in fact at the equator the days are about the same length of time all year long. At the North Pole where it gets very cold in the winter, they have almost six months with no sunshine at all.

[Jane] And we're getting into that time of year right now, right? For places that are far up north places like Iceland or Greenland it's pretty dark there right now.

[Mark] Yes, it's very dark in Iceland. In some places they only have about one hour of daylight.

[Jane] Wow. All right let's get into another question and this will be right up your alley given how you got started, Mark. This is from Corey.

[Corey] I wanna know where snow comes from, real snow!

[Mark] Corey, you might be surprised at this answer because snow is how clouds make their precipitation: both rain and snow. So even in the summertime when it's raining outside, those raindrops started as snowflakes. So when you ask where snow comes from it certainly comes from the clouds. But what happens is when the moisture near the ground moves up into the air, turns into clouds, the air above is so cold that the little bit of moisture turns into, well, you could sort of think of it as frost, hanging around in the air. Those are the little ice crystals that we call snow crystals, or snow. When it gets heavy enough it starts coming down. Of course, in the winter when it's colder it's cold all the way down to the ground so it stays as a snowflake. In the warmer months, the snowflakes melt on their way down and that's how we get rain.

[Jane] So Mark how do we get freezing rain or sleet or hail, which is not snow but isn't water either?

[Mark] That's right. What happens is the temperature in the clouds makes a difference. So that let's say we have a snowflake coming down and the cloud is warm, it'll melt into a raindrop. But if the air next to the earth is still cold then the raindrop falls into that cold air, and two things can happen if there's a lot of cold air, the raindrop refreezes, turns into this tiny little pellet of ice we sometimes call that sleet. If it isn't a lot of cold there but it's still cold on the ground, maybe the trees are cold or the road is cold, the water drop falls and when it lands it freezes right on contact, so you get ice on roads and sometimes ice on trees.

[Jane] And how do you get those really huge balls of hail that sometimes fall where it's the size of a golf ball and it'll break somebody's car?

[Mark] Those large balls of ice, those what we call hailstones, come from very large clouds that are really thunderstorms. The air inside thunderstorms goes up and down. And if the raindrop goes back up into the top of the cloud it freezes into a little tiny pellet of ice. As it comes down, it might not get down to the ground. And if it goes back up into the cloud it has a little bit more water on the outside it freezes and gets a little bit larger and it can do this sometimes a few times, sometimes many times, and eventually it gets so large that it falls to the ground and that's how we get hail.

[Jane] Have you ever looked up at the sky and thought maybe you saw a rabbit or a lion or a rabbit morphing into a lion? Clouds are pretty wonderful and mysterious. Sometimes they look like a gray sheet that's been spread across the sky. Other times

they're like fluffy cotton balls shape shifting in front of your eyes and sometimes clouds turn the sky almost green and signal some extreme weather is heading your way.

Our first question about clouds comes from Maya who's 8 years old and lives in Shelburne, Vermont.

[Maya] How are clouds made and why they're there?

[Mark] The clouds that you see out there, Maya, and I think that's a good opportunity to try to figure this out. When you look, of course, they're up in the sky. And how did they get there? Well they come from moisture, but the moisture has to go up into the air. And as the moisture goes up, as you go up higher in the air, it gets colder. If you think of mountaintops for example, mountaintops are very cold. So when the moisture goes up it basically turns into fog way up in the sky. And as that fog collects together we get clouds. And depending on whether the air is going up or coming back down, they'll either stay there, or if the air starts to come back down, it tends to dry the clouds out and that's why the skies sometimes clear and we get some sunshine.

[Jane] Ella, who is 4, sent us a question all the way from Bern, Switzerland. She was too shy to ask her question in English. So she speaks Swiss-German. And then you'll hear her mom will translate last question into English for us.

[Ella's mom] In English, that would be how did the clouds fill themselves with water?

[Jane] When you're looking up at the sky, Ella, you see those clouds there, they appear to be kind of fluffy and light. What's happening though is that moisture, even invisible moisture, moisture you can't see, is going up into the sky. And what happens is warm air is light and you can sort of think of a hot air balloon, they float in the air. And so some of the moisture floats in the air as it goes up into the sky it cools off and it turns into tiny, tiny little droplets, and those tiny little droplets become the cloud. So what happens is, if the air is going up over let's say a big ocean or even a big lake, that helps moisture to go up into the sky. And that's how the clouds fill up with water.

[Asher] I live in Lincoln, Vermont. My name is Asher, I'm five years old. My question is why do clouds stay up in the sky?

[Mark] Asher, that's a great question. And well it's kind of odd, but clouds actually are falling all of the time. Don't worry they're not going to fall down on you and even if they did they don't hurt. They're very light. But how do they stay up in the sky? The same idea of moisture going up into the sky means that the air is going up. Now, clouds are made of tiny, tiny little droplets. In fact if you've ever been outside when it's foggy you've been in a cloud and sometimes, just sometimes, you can even see little tiny, tiny, tiny specks of water in the sky if it's a foggy morning. Those light little tiny droplets are the

cloud droplets and of course they're very tiny so they're not very heavy. When the air is going up it actually pushes those little tiny droplets up into the sky. So even though we see it floating up there it only is up there because the air is going up and lifting it up there.

[Jane] It seems kind of strange, Mark, that the air is lifting the clouds up with the moisture in them and then the moisture is coming back down as precipitation. And that's you know what we're getting with the snow and rain. It seems like kind of a funny system that it's being pushed in both directions.

[Mark] Well, if you think about how fast the air is going up I think that's an important idea. The air that's going up isn't rushing up terribly quickly and so little droplets stay up. When they get heavier bigger pieces of either ice, or snow, or some rain drops, they're too heavy for that air that's going up to hold them up and so they come back down.

[Jane] OK one more cloud question here.

[Lexy] Hi, my name is Lexy and I'm age six and I live in Hirsch, Texas and my question is why do clouds have different shapes sizes?

[Jane] OK, Lexy. Well, the clouds which are made by air that goes up and then it gets cooler, and we end up with little droplets of water up there, we sometimes call it fog if it's on the ground, but up in the sky we see it as clouds. But it depends on what the air is doing where those clouds are. If the air is going up pretty quickly, the clouds grow large and lumpy, and we call those clouds 'cumulus clouds.' If the air is moving sideways very fast the wind is blowing very strong up where those clouds are, it tends to spread those clouds out and they get thinner.

Also if the clouds are very high up, up where the jets are traveling, it's so cold that instead of tiny little water droplets the cloud is made of tiny little ice crystals and sometimes they're so thin that the sun can shine through them. So we sometimes see it looks almost like a milky sky. And you can see the sun through them. So those are the different kinds or shapes of clouds.

[Jane] And what do you call the cloud that looks like a bunny rabbit?

[Mark] The cloud that looks like a bunny rabbit, that would be one of those cumulus clouds. Cumulus actually means puffy.

[Jane] What's your favorite shape that you see? Do you have one that you see a lot in the sky when you look up that you often think oh that looks just like a blank.

[Mark] Well I guess I don't think about them in terms of you know maybe looking like a dragon or something, but one of my favorite clouds looks almost like a flying saucer.

They are these big kind of flat almost pancake shaped clouds and they happen when the air is blowing very fast but kind of bumping up and down a little bit. Every time the air bumps up, it makes this little kind of pancake shaped cloud.

[Jane] And one of the things that I think is amazing about clouds is they sometimes look really kind of solid, like if you could run through it, it would be like going through a ball of cotton or you know something thicker than cotton candy. But then you go on a plane ride and the plane breezes right through the clouds and you realize that it's just kind of foggy air. They look different than they actually are.

[Owen] My name is Owen. My age is five. I live in Pennsylvania. How do rainbows come from sun and rain? And how do the rainbows appear?

[Mark] So I hope you'll like rainbows, Owen. They really are fun to look at and you're right you have sun and rain together. So a couple of ways to think about this: a very smart man who lived many, many years ago, Isaac Newton figured out that sunlight is not one color. We see it as one color but he actually figured out there are lots of colors what we see is the rainbow. In order to figure this out, he used a special piece of glass and it took all of that light in a kind of spread it out. And when it spread out it turned into the different colors that we see. The same thing happens with a small piece of glass that sometimes people hang in their windows. They sometimes call them crystals and when the sunlight comes through they put little tiny rainbows all around the room. That's kind of fun to look at.

In the sky, that's what the raindrop does. When the light comes into the raindrop. It actually bounces around but it spreads out and if spreads out, you see the different colors.

[Hank] What are thunderstorms?

[Jane] Hank is two and a half and he wants to know what are thunderstorms?

[Mark] Ah, thunderstorms are one of those exciting and sometimes scary things that the weather does. It has to do with a warm day. Usually on a warm day when the air gets quite warm, it starts going up. And if it has moisture in it, it turns into clouds. But on a warm day the year's going to go up higher into the sky it's going to rise quicker and make a very tall cloud. And what happens in these tall clouds is that the very top of the cloud is very cold and it starts snowing on the top of the cloud. Now snowflakes actually make a lot of static electricity. That's what happens, like if you had just stocking feet on and you shuffle across the rug you can get a little shock or a little zap. And that's what happens between the snowflakes. They build up this static electricity. And in this case instead of going across the room, it comes from the top of the cloud down to the ground

or sometimes even from the ground up into the cloud. That big spark is what we see as lightning and that makes the thunder and that's why we call it a thunderstorm.

[Jane] So if you've heard it described as hot air and cold air coming together and colliding. Is that accurate? I mean is that in sort of an oversimplified way of saying it.

[Mark] Yes I think that's a good way to say that, that's oversimplified, that usually in order to get a thunderstorm it helps to have some cold air around because warm air is lighter than cold air. So if the two of them are nearby the cold air often goes underneath the warm air so it kind of gives it a boost, gives it a push up and that helps to make the thunderstorm.

[Jane] And you mentioned Mark that lightning is what happens at that time period and that's what makes thunder and we experience those two events separately. We usually see lightning and then you hear thunder but it's really the same thing. The noise of the thunder is from that lightning but because light travels faster than sound we hear them separately.

[Mark] That's right. And in fact when I mentioned shuffling across the rug with your stocking feet and you might get a little shock if you touch say a doorknob or something. You can sometimes hear a little tiny snap or a click and you can feel it too. That's actually a lightning bolt.

[Jane] Cool.

[Mark] Bbut it's very, very, very, very tiny lightning bolt.

[Jane] Thank goodness.

[Mark] The whole lightning bolts that come from the clouds can sometimes be more than a mile long. And that takes a lot of electricity. And so instead of a tiny snap you get a big bang but you're right. You see the light first and then you hear the sound.

[Jane] So I learned when I was little that you can count how long it takes to hear the thunder after you see the flash of lightning and it'll tell you how close that lightning was.

[Jane] And how do you do that calculation?

[Mark] I remember either counting alligators or Mississippi. Maybe you say one Mississippi, two Mississippi and you keep counting like that if you get to five Mississippi's the lightning is one mile away.

[Jane] And if you're seeing the lightning and then hearing the thunder before you get to five Mississippi's that means that storm is pretty close and you should probably make sure that you're in a safe place.

[Mark] That's right and the safest places to go during a thunderstorm are inside buildings. That's always the best recommendation.

[Jane] All right so while we're talking lightning here is another question.

[Jake] I'm Jake. I live in Denver and I'm eight years old. And I'm wondering because I'm sitting in a lightning storm right now, how hot is lightning?

[Mark] That's a great question Jake. Lightning is surprisingly hot.

In fact lightning is 5 times hotter than the outside of the sun. It's about fifty thousand degrees and so in that very instant where the lightning happens it is also extremely hot.

[Jane] Oh my gosh so you would never want to touch lightning.

[Mark] No. And you wouldn't want it to touch you either.

[Jane] From thunderstorms, let's go to another extreme weather event.

[Eliana] My name is Eliana. I'm five years old and my question is how do tornadoes happen?

[Jane] Eliana lives in Maputo, Mozambique.

[Mark] OK now tornadoes happen when we have thunderstorms but it's a special kind of thunderstorm. It's a thunderstorm where the air is going up and down very quickly. And if it's going up and down sometimes the air inside the bottom of the thunderstorm starts spinning around. If it spins around sideways it's fine. But every once in a while that spin starts tipping down. And so the spin starts coming down from the cloud. Now to make such a strong thunderstorm, to make a tornado, we usually have a lot of hot air around and some cold air nearby.

The cold air does two things. It helps to push the warm air up to make the thunderstorm very tall. It also is a little bit drier and that dry air actually helps to make the thunderstorm spin a little bit better. In fact during a tornado, usually the thunderstorm has already moved by. The rain has stopped and then the tornado happens after.

[Jane] Mark, we have one more weather question, do you think you can handle one more?

[Mark] Oh, sure.

[Jane] All right. Here it is.

[Julius] Hello I am Julius and I live in Ohio. I'm eight years old. I have a question, how does wind get made?

[Mark] OK Julius. That's one of my favorite things to talk about because I always wondered that as a kid. It kind of looked like the trees were pushing the year or maybe if you're looking at the water the waves are moving the air but it's the other way around. The wind of course is air that's moving. So one of the things that you can think about is that warm air is light. It actually floats but cold air is heavy and it sinks. In fact you can even try this out. Maybe in your kitchen if you have a freezer on top of your refrigerator and you open the freezer door for just a minute and you put your hand out you can feel the cold air falling down onto your hand. And perhaps you've seen a hot air balloon. When they heat up the air in the balloon, it makes it lighter and it goes up. So those are places where the air is going up or down wind of course go sideways. And here's how that works. When the air goes up something has to take its place. And so the air comes in from the sides and that's really what happens with wind. Air that's going up in one place and sinking in another, they start making a little bit of a cycle a little bit of a turn. And so the air goes from one place to another and that's what wind is.

[Jane] There are different names for different kinds of winds around the world. Why is that, it seems like wind is just one thing.

[Mark] Oh but I think we feel wind in lots of different ways and wind really brings all kinds of things to us and can bring smells and aromas. It can change the temperature quite quickly. One of my favorite names for a wind is called the Chinook which comes from the Rocky Mountains but the air when it comes down warms up and it dries out and sometimes it actually can quickly melt snow during the winter. In fact that's what the word Chinook means. It means snow eater.

[Jane] So our listener Jake in Denver who asked about lightning might be able to experience a Chinook wind.

[Mark] Oh very much so they have that very often.

[Jane] There are lots of different types and names of winds. Some of them have stories or mythology that has built up around them. When I lived in Los Angeles people liked to say that the Santa Ana winds made people crazy. The Santa Anas are a lot like the Chinook that Mark was talking about, a strong, dry, warm wind. Have you ever seen the movie *Mary Poppins*? Well, you might remember that Mary Poppins floats into the lives of Jane and Michael Banks on a strong wind. And she leaves again when the wind changes direction. Winds are powerful. So it's no wonder myths have built up around them. Can you think of any stories that talk about the wind as an almost living force?

Now, by the way if you're interested in learning more about wind and clouds and rain and tornadoes and snow you should check out Mark Breen's book. It's called the *Kids' Book of Weather Forecasting*. And Mark has an experiment that you can try at home.

[Mark] I guess one of the things that I found very helpful when I was a kid was to watch what the sky was doing. One of my favorite things that I remember was that somebody once told me we were watching a beautiful sunset and he said to me 'red at night sailor's delight.' Now I'm not a sailor. He wasn't a sailor so I asked him what does that mean. And he said that well if you watch the sky sometimes you can find out what the weather is going to do. So the red at night means a beautiful sunset but it meant the next day. A sailor's delight was going to be a nice day. And so I think just watching the sky and kind of keeping track of what you saw that might be a great thing to try out.

[Jane] Mark, thank you so much for talking with us. We really appreciate all of your expertise on all of these very many weather questions.

[Mark] You're welcome and thanks to all those kids for all those great questions.

[Jane] As always if you have something you're curious about have an adult record you on a smartphone and send your question to [questions@butwhykids.org](mailto:questions@butwhykids.org).

Be sure to include your first name your town and your age along with your question. We can't answer every question but we're trying our best to get to as many as possible.

But Why is produced by Melody Bodette and me, Jane Lindholm for Vermont Public Radio. Our theme music is by Luke Reynolds. We had additional sounds and music this week from Adam Selzer and Samuel Corwin. We'll be back in two weeks with an episode about something kids tend to love, chocolate. Do you love chocolate? And something many of you hate: coffee. So stay tuned for coffee and chocolate in two weeks. And until then, stay curious!