The Secret World of Weather

What’s in it for me? Learn a whole new language in just a few blinks – the language of weather.

Have you ever left the house after checking your weather app, expecting a full day of sunny weather – only to be drenched later? Weather forecasts rarely feel spot-on because they rarely talk about the weather you actually experience. Meteorologists are less concerned with telling you whether you need to pack an umbrella than with studying large climate patterns over wide areas. But your weather happens on a much smaller scale. It’s shaped by your immediate surroundings – from buildings and trees to localized winds and rock formations. But here’s the great news: you can learn to read these patterns. These blinks reveal the secrets and clues that will help you make more accurate predictions than any computer-driven forecast ever could. Along the way, you’ll learn

why it should worry you when clouds blow in different directions; why prey animals turn their rear ends to the wind; and why summers in the city are so hot.

Learn to read local microclimates and you’ll be able to predict the weather better than any meteorologist.

The origin story of the weather forecast is not a happy one. In nineteenth century Britain, Robert FitzRoy, the famous Royal Navy vice admiral who captained Charles Darwin’s voyage on the Beagle, was appointed to the newly established Meteorological Office. FitzRoy was tasked with formalizing earlier, less scientific attempts at predicting the weather. By collecting daily weather data on land and using his own nautical charts, he was able to make more sophisticated and accurate predictions than his contemporaries. He called his predictions “forecasts.” But many didn’t think weather forecasting was even possible, and FitzRoy paid a high price: whenever his predictions were wrong, the public shamed him so vehemently that he became deeply depressed. In 1865, he took his own life. Today, meteorologists have many more tools than FitzRoy ever had. Still, we often complain how inaccurate the weather forecast is. Are meteorologists really that bad at their job? Or are we like FitzRoy’s critics, holding them to an unrealistic standard? Here’s the key message: Learn to read local microclimates, and you’ll be able to predict the weather better than any meteorologist. The reason that our own experience often contradicts the weather report is that meteorologists make their predictions on the macro-level: they consider big weather trends over wide areas. But we experience weather on the micro-level. In a big city, for example, it sometimes rains in one area, but stays completely dry in another. And it’s all down to microclimates. Microclimates are directly shaped by our environment and its distinct features – whether trees, buildings, hills, or different types of soil. Sometimes, microclimates can vary wildly over just a few meters. Consider the 800-meter-high ridge in the Jura mountains on the border of France and Switzerland. It’s only 50 centimeters wide, but the climate on each side is so different that it’s created two completely distinct ecosystems. If you’ve ever sought shelter under a tree on a hot day, you’ve

already experienced the power of a microclimate. Trees don't just provide a cooling shadow in summer; any breeze is also stronger around their trunk, thanks to an effect known as the "tree fan." Microclimates come with their own clues that even the best meteorologist with the fastest computer can't fully map. If you want to know what the weather will really be like, you need to know how to read these clues. And that's where these blinks come in: they'll encourage you to pay close attention to the weather signs in your environment and show you how to interpret them – starting with our puffy friends in the sky: the clouds.

When it comes to understanding weather trends, clouds are your best friends.

When you want to know what the weather is like, looking at the sky is probably your first instinct – and it's a good one! Clouds are the first and best indicator of the three major components of weather: air, water, and temperature. Even if you're not a nature expert, you could probably recognize a big, dark rain cloud hanging over your head. But there's a whole art to understanding what Micronesian navigators call the "talk of the skies." First, let's get to know the three big cloud families. There are cirrus, stratus, and cumulus clouds, and all of them tell us different things about weather conditions, in the present and in the future. The key message here is: When it comes to understanding weather trends, clouds are your best friends. Cirrus clouds are wispy, icy-white strands high up in the sky that look like feathers, hair, or cotton candy. Sometimes they have the shape of a comma, with a larger head and a trailing tail. The tail is a great indicator of which way the wind above is blowing. The longer it is, the stronger the wind. When cirrus clouds grow longer, thicker, and more numerous, it's often an early warning of approaching bad weather. Stratus clouds are flat, wide blankets that cover broad patches of sky. These clouds are slow, and indicate a pretty stable atmosphere. Whenever you have one above you, you can be sure that the weather won't change for a while. Sometimes, unfortunately, this means a full day of rain. Cumulus clouds are fluffy and white with big bulges and flat bottoms. Think of the clouds in the opening sequence of The Simpsons. Cumulus clouds form when warm air rises from local heating on the ground. That's why you often find them over cities, and more often in the afternoon, when the sun has had time to warm the earth. Because they form through localized heating, cumulus clouds are always a sign that the atmosphere is not quite stable. The taller they are, the greater the instability. And the lower they hang, the higher the humidity in them. When these two things combine, heavy rain showers will likely follow very soon. There are other variations, but if you can recognize the big three, you're already well on your way to understanding the talk of the skies. But beware: if you see all three cloud types at once, it's a sign that the atmosphere is unstable – and bad weather is coming.

The wind we experience is closely shaped by our environment.

Once you start studying clouds, you'll notice they can move pretty fast. Sometimes they even move in different directions. Just as there are three types of cloud, there are three

types of wind that shape our weather: the ground wind, the main wind, and the high wind. The high wind is the one that moves the cirrus clouds. It blows so high up that it isn't much affected by the landscape below. The main wind blows closer to the ground, over wide areas of land. When weather forecasts talk about wind, that's the one they mean. But we most often experience ground winds – these are local winds that are strongly shaped by the landscapes they blow through – such as mountains, valleys, buildings, and even small rocks. The key message here is: The wind we experience is closely shaped by our environment. Wind is channeled, diverted, sped up, and slowed down by the objects it encounters. Remember the cooling "tree fan" from Blink 1? That's an example of a ground wind accelerating as it passes a tree. Many local wind effects are so distinct that they have their own name. The tramontane, for instance, is the wind blowing through the gaps of the Alps in the north of Italy. But where does all this wind come from to begin with? Wind originates when a high pressure air mass – a warm front – clashes with a low pressure air mass – a cool front. The air flows clockwise around high pressure systems and counterclockwise around low pressure systems. So when the two meet, things get turbulent. When the wind is very strong or changes direction, or when the main wind and the high wind blow in different directions, it's a sign that the air masses around us are shifting. And whenever that happens, the weather will shift, too. And if the wind shifts from south to north, it's usually a sign that bad weather is coming. You'll find that your surroundings have their own unique wind patterns. As you start to read them, compare what you hear on the weather forecast with what you observe on the ground. When a change in the weather is predicted, study the wind just before. Over time, you might notice that, for example, when the wind blows from the church to the hill instead of the other way around, it starts to rain a couple of hours later. Soon, you won't need the forecast!

Dew, frost, rain, and snow are closely related weather phenomena.

Many of us prefer our weather warm and dry over cold and wet. So, while we can't change the weather, knowing when we're about to get cold or wet might make life a little easier. There are many different types of cold and wet. In this blink, you'll learn how to read just a few of them: dew, frost, rain, and snow. Dew forms when the air around you reaches its dew point. That's the temperature at which the vapor in the air condenses to water. For that to happen, the air needs to be very humid and the ground very cold. As we'll see later, these are also the perfect ingredients for fog – which is why dew and fog often go together. The key message is: Dew, frost, rain, and snow are closely related weather phenomena. When it's so cold that dew freezes, or the vapor in the air freezes right away, we get frost. If you follow frost through a landscape, you'll find it thins out under trees and on higher ground, and certain plants have more than others. That's because of the small temperature changes you get with different heights, substances, and wind conditions. So, dew and frost form when moist air comes into contact with cold ground. Their cousins, rain and snow, form when moist air comes into contact with the cold at high altitudes. This means that the bottom of a cloud marks the point where the air is cold enough to reach its dew point. There are two types of rain cloud. Cumulonimbus are big, dark clouds of the cumulus family. They create short but intense rain showers that can be highly localized. Their most important feature is that they're taller than they are wide. And the taller they are, the more intense the rain. Stratonimbus are wide, gray clouds that create rain blankets which can last for hours. They're shaped by broader weather patterns, such as when a warm and cold front

collide. The same clouds are responsible for snow – it just needs to be cold enough for the rain drops to freeze, and stay frozen as they fall to the ground. The colder it gets, the smaller and drier the snowflakes become – until you get the very fine, powdery snow you sometimes find in deep winter.

Animals and plants can help complete our picture of local weather conditions

Have you heard the old lore that cows lie down before it's about to rain? Throughout the centuries, farmers and scientists have tried to predict the weather by studying the behavior of animals. Sadly, the cow thing isn't really true. Cows lie down whenever they want. But many animals do react to the weather in specific ways, and can provide us with plenty of clues for our predictions. One of the simplest, scientifically proven links between animals and weather is that spiders spin smaller webs when it's windy. Other animals react to the wind, too. Here's the key message: Animals and plants can help complete our picture of local weather conditions. Prey animals like horses tend to stand with their backs to the wind. It's not because they like a cool breeze – it's because their rear ends mark their blind spot. With the wind behind them, they can better hear predators approaching. Birds, on the other hand, like to face into the wind, because it makes it easier for them to take flight, so if they face in different directions over the course of the day, it can be a sign that the weather is about to change. Birds give us other subtle clues about the atmosphere. If they glide through the air effortlessly, for example, then the air is stable. But if they fly high, it's usually a sign of an unstable atmosphere, and can even warn us of storms. Now let's turn from fauna to flora. Because, amazingly, plants can help us predict the weather too. Many flowers like dandelions, daisies, and buttercups close their petals when rain approaches or the temperature drops. Even more importantly, plants give us an idea of the typical weather conditions for an area. For instance, grass stops growing below 5 degrees and above 32 degrees Celsius. So if you see very long grass, it's a sign that you're in a relatively temperate zone. Plants with thick, fleshy leaves tell you that you're in a hot and dry area. And if the leaves around you are unusually big and pointy, you're somewhere wet and shady – like the rainforest. Animals and plants don't usually provide the first clues of changing weather. For that, we're better off looking at the clouds or listening to the wind. But they can complete the picture we draw of local microclimates – by giving us clues about typical weather conditions.

From a safe distance, extreme weather like fog, storms, and hail can teach us important lessons.

One fateful December night in 1990, 99 vehicles crashed in a mass collision on a freeway in Tennessee. Twelve people died, and fifty more were injured. The culprit? A thick and impenetrable fog that covered the road like a white blanket. Extreme weather like storms, hail, and yes – even fog – can be deadly, which is why it's important to know their early warning signs. These phenomena also tell us a lot about the physics of weather. Fog, for example, forms when the air is so full of water that it can't hold any more of it. If the ground is unusually cold or wet, or the temperature drops, then water

vapor condenses into tiny droplets that hang in the air. They refract the light and block our view – sometimes so much that we can't see the road we're driving on. The key message? From a safe distance, extreme weather like fog, storms, and hail can teach us important lessons. Another awe-inspiring weather phenomenon is the storm cloud. Storm clouds form like regular cumulonimbus clouds, but they grow much taller, and keep growing until they hit the tropopause, a natural barrier in our atmosphere where the temperature stops falling and actually starts rising a little – usually between 9 and 17 kilometers above ground. Once the storm cloud hits the tropopause barrier, it spreads out under it until it covers most of the sky. Luckily, storm clouds never last long: they have an average lifespan of about 90 minutes. But at their peak, they have as much energy as an atomic bomb. This energy is released in the form of lightning, thunder, rain, or snow – sometimes all of them. Under the right conditions, they can even produce tornadoes and hurricanes. They're also responsible for hail, which forms when the air in a storm cloud gets so turbulent that it lifts water droplets to higher levels, where it's cold enough for them to freeze. Sometimes, a forming hailstone is lifted in this way multiple times, growing thicker and thicker with each new layer of ice. The biggest ones can weigh as much as one kilogram! So when extreme weather approaches, your first instinct should always be to find shelter. (Those one-kilo hailstones should be reason enough!) But if you can, watch what's going on from a safe distance, and you'll learn a lot about the powerful components that make up our weather.

Different landscapes – like forests, islands, and cities – all produce their own special microclimates.

Microclimates are shaped by the distinct features of our environment. This means that certain landscapes produce weather patterns that are unique to them. Trees, for example, are especially good at creating their own climate. Their distinct sun and wind shadows keep woodland warmer than surrounding areas in winter, and cooler in summer. But did you know that temperature differs even between tree species? Take fir trees. They're extremely good at holding heat under their canopy. In winter, it can be ten degrees warmer under a fir than under a bare oak tree. Some trees are also better umbrellas than others – surprisingly, the many skinny needles of a Norwegian Spruce actually hold water better than the broad leaves of other trees. Something to remember the next time you find yourself in a sudden rain shower! The key message is: Different landscapes – like forests, islands and cities – all produce their own special microclimates. Islands, too, tend to have unique weather systems. For one, they often have more temperate climates than land-locked regions, because the sea counterbalances warm and cold fronts. In winter, the sea takes longer to cool than the air, and acts as a heat battery for the environment. In summer, it takes longer to warm, and so cools down its surrounding area. Islands produce special clouds for the same reason. When the moist sea breeze meets the warm earth, it creates cumulus clouds that hang right above the land. Cities operate in a similar way, as virtual "heat islands," because buildings and roads heat up much faster than trees, fields and the earth. In summer, a city can be up to 12 degrees warmer than the countryside. This heating effect is also the reason you'll often find cumulus clouds above cities. The localized heating also creates its very own wind: the city breeze. City wind is particularly notable, because it has so many flat, smooth surfaces to bounce off. When a strong wind hits a

tall building, it splits into 6 new big winds, including one that's sometimes called "The Monroe Effect," because it bounces off the ground to create an upwards waft of air that can lift skirts! See how many others you can detect next time you're near a tall building. Just like the natural world, urban environments provide plenty of weather patterns to discover. All you have to do is tune into your senses and listen to the secret language all around you.

Final summary

The key message in these blinks is that: The weather we experience is shaped by our local environment – whether that's a forest, an island, or a city. Clouds, winds, animals, and plants give us clues about local weather patterns, and can help us predict weather trends for the near future. Thanks to these blinks, with a bit of background knowledge and a lot of careful observation, you too can become your own weather forecaster. Actionable advice: Force yourself to appreciate the art of weather. When you begin your journey of nature exploration, you may find it hard to care about all the tiny visual details of the sky. To practice the art of reading the sky, study it very closely for a few minutes. Now, close your eyes and imagine you were describing the sky to an artist friend who's about to paint it. If you do this often enough, you'll soon come to understand the unique artwork that is the sky.