

# Wendy and Her Worldwide Weather Watchers



Wendy loves weather. She watches weather come across the Potomac River outside her kitchen window while she eats breakfast and watches weather forecasts on the TV. On her bookcase is a weather atlas, and she follows reports of severe weather on the World Wide Web. Wendy is planning to be a meteorologist.

It's no accident that weather is of interest to Wendy—she's seen a lot of it. Her dad is an agricultural consultant for the government, so Wendy's family has traveled around the world. She's been rained on in the rain forest, baked in the desert, blown over on the open plains, and nearly frozen in the tundra.

As a result of her travels, Wendy has made a lot of friends around the world. And she keeps in touch with them by e-mail all the time. They have formed a little weather study group and often share information about the weather in their local areas. They like to call themselves the Worldwide Weather Watchers. Some people put a finger in the air to figure out which way the wind is blowing; Wendy puts a finger on her keyboard.

On June 20, Wendy listened to a TV weather report. The meteorologist announced that the summer solstice would be tomorrow, on June 21. He said it would be the longest day of the year. You can count on more daylight

on the solstice than you will see again for a whole year.

"Summer solstice...longest day of the year...I need to find out more about this," Wendy thought. "I think

I need some help from the Worldwide Weather Watchers." She went to her computer and sent out a message to all of her friends. It said,

*Here in Virginia it is the summer solstice on June 21. It is going to be the longest day of the year. What I want to know is if it is going to be summer solstice in your town, and if it is the longest day of the year for you, too. I'm also wondering, if it is the longest day of your year, how long is it?*

*What I would like you to do is find out when sunrise and sunset are in your town. If you give me those two pieces of information, I can figure out the rest. I plan to be up the whole day. I'm setting my clock to get up early so I won't miss a minute of the longest day of the year.*

*Thanks for helping me with this project. Wendy*

Before going to sleep that night, Wendy rechecked her clock radio to make sure it was set for 5:30 a.m. As she pushed her clock back into place, her computer beeped. It was her first report—her friend Shawn from Auckland, New Zealand. The message didn't seem right, though. Shawn reported that the Sun rose at 7:48 a.m. and would set at 4:55 p.m.! That was just over 9 hours of daylight. How could that be the longest day of the

year? Had she heard the TV meteorologist right? Had Shawn reported his numbers incorrectly? Wendy climbed into bed, pulled the covers up around her chin, and let the questions turn over in her mind as she drifted off to sleep.

Wendy awoke to "a 40% chance of thunder showers by late afternoon, clearing by nightfall. Winds from the southeast at 10 knots...." She bounced out of bed and pulled back the curtain. Dark! Yes, up before the Sun. She checked her e-mail and found three more reports from the Weather Watchers: Hiroko from Sendai, Japan; Seeta in New Delhi, India; and Makindu in Nairobi, Kenya.

Wendy hurried down to the kitchen for breakfast. The kitchen window had the best view to the east. Already the darkness on the horizon was yielding to the first suggestion of sunrise. By the time Wendy took her first bite of toast, a line of orange had pushed between the horizon and the darkness above. The kitchen clock showed 5:40 a.m. Sunrise had to be pretty soon. Wendy peeled an orange. The sunrise intensified and color moved across the bottoms of the clouds. She could see the brightest place on the horizon clearly now. Night had been replaced by the gray of early morning. Then the very tip-top of the red orange Sun peeked over the horizon. Wendy glanced at the clock. It was 5:44 a.m.—sunrise on the summer solstice.

Wendy watched as the complete disk of the Sun glided free of the horizon and hung suspended in the sky. Then she returned to her bedroom to check her computer for more messages. Justin from Punta Arenas, Chile;

Maria from Quito, Ecuador; Billy from Barrow, Alaska; and Elke in Stockholm, Sweden. She read through the reports quickly, but the information was all a blur. There didn't seem to be a pattern to the data. How could she make sense of them?

She wrote down the sunrise and sunset times and returned to the kitchen. Her dad was opening the paper and eating yogurt. "Dad, I got up to see the sunrise because this is the longest day of the year. I'm going to see all of it. The Sun first appeared at 5:44, and I plan to see it go down, too."

"Good for you. Where will you go to watch the sunset? Our apartment has a great sunrise view, but no sunset view."

Wendy gulped. She hadn't thought of that. "I don't know," she admitted.

"How about this for a plan. I'll make sure I'm home in time for us to go up on top of the building to see old Sol set. What time will the Sun be setting?"

Again, Wendy was caught off guard. Her dad tossed her the paper and said, "Look it up. I need to gather a few papers before I head off. Give me the time on my way out."

"Of course," breathed Wendy, "the weather page." She dove into the paper, threw it open to the weather page, and quickly found the information she wanted. June 21, summer solstice, sunrise at 5:44 a.m., sunset at 8:37 p.m.

"Sunset is at 8:37 p.m.," Wendy called up to her dad, "but could you be here a little early? I don't want to miss this."

"I'll be here in plenty of time."

Wendy returned her attention to the e-mail data. She decided to organize the numbers in a chart. After thinking about it for a while, she put the cities in order from east to west, starting with New Zealand. This is the chart she produced.

lived. She particularly wanted to see what might account for the huge difference in daylight between Justin's home in Chile and Billy's in Alaska.

"Hmmm," Wendy thought, "Justin lives way

City and country	Sunrise	Sunset	Length of day
Auckland, New Zealand	7:48	4:55	9:07
Sendai, Japan	4:18	7:06	14:48
New Delhi, India	5:22	7:18	13:56
Nairobi, Kenya	6:34	6:34	12:00
Stockholm, Sweden	2:48	8:59	18:11
Punta Arenas, Chile	8:00	3:32	7:32
Alexandria, VA, USA	5:44	8:37	14:53
Quito, Ecuador	6:22	6:22	12:00
Barrow, AK, USA	None	None	24:00

Wendy studied the chart. The hours of daylight varied widely, from less than 8 hours to 24 hours. More information would be needed to make sense of the data. She went to her weather atlas, opened to the map of the world, and located the countries in which her Worldwide Weather Watchers

down in the southern tip of South America, and Billy is close to the North Pole in Alaska. I think I need to add latitude to my chart and put the cities in order from northernmost location to southernmost location." When Wendy added latitude to her chart and reorganized, this is what she saw.

## June 21

City and country	Latitude	Sunrise	Sunset	Length of day
Barrow, AK, USA	71°N	None	None	24:00
Stockholm, Sweden	59°N	2:48	8:59	18:11
Sendai, Japan	38°N	4:18	7:06	14:48
Alexandria, VA, USA	38°N	5:44	8:37	14:53
New Delhi, India	28°N	5:22	7:18	13:56
Quito, Ecuador	0°	6:22	6:22	12:00
Nairobi, Kenya	1°S	6:34	6:34	12:00
Auckland, New Zealand	37°S	7:48	4:55	9:07
Punta Arenas, Chile	53°S	8:00	3:32	7:32

One thing became clear to Wendy. Latitude did relate to the length of the day. But why did locations in the northern latitudes have longer days than locations in the southern latitudes? And did northern locations always have longer days, or were days longer in the south at a different time of the year? More data would be needed to answer these new questions.

The U.S. Naval Observatory maintains lots of information related to Earth motions in the Solar System. Wendy had used their website in the past to check on the phases of the Moon. She thought she might find sunrise and sunset data there. To her delight, she could call up the sunrise and sunset data for any location on Earth for any day she chose. What a great resource! But what should she look up?

Some little voice inside told her to check the sunrise and sunset data for a date exactly half a year earlier. It took almost an hour to get the data, but it was worth the effort. This is

the table she produced for sunrise and sunset on the winter solstice, December 21, for the previous year.

“Very interesting!” Wendy commented to herself. “The locations that have the longest days today had the shortest days half a year ago. And vice versa; the places with short days today had long days half a year ago. But look at Nairobi and Quito. Their days stayed the same all the time—equal amounts of daylight and darkness.”

It *was* interesting. Wendy thought about day length all afternoon. She discovered that, if she added together the summer solstice day lengths for her town, Alexandria, and Shawn’s town, Auckland, the sum was just about 24 hours. Alexandria and Auckland are almost the same latitude, but one is north and the other south. She also found that, when she added together the length of the day on the summer solstice and the winter solstice for any city, the sum was very close to 24 hours. What did it all mean?

## December 21

City and country	Latitude	Sunrise	Sunset	Length of day
Barrow, AK, USA	71°N	None	None	00:00
Stockholm, Sweden	59°N	9:53	16:03	6:10
Sendai, Japan	38°N	7:00	4:32	9:32
Alexandria, VA, USA	38°N	7:23	4:50	9:27
New Delhi, India	28°N	7:03	5:31	10:28
Quito, Ecuador	0°	6:14	6:22	12:08
Nairobi, Kenya	1°S	6:24	6:35	12:11
Auckland, New Zealand	37°S	4:56	7:37	14:41
Punta Arenas, Chile	53°S	3:50	8:46	16:56

Right on the stroke of 8:00 p.m., Wendy's dad came through the door. "What a day! This feels like the longest day of my life. I'm bushed."

"It *is* the longest day...at least of the year...at least for us. Did you know this is the shortest day of the year for Shawn and Justin?" asked Wendy. Her dad raised his eyebrows. "Come on, Dad, let's go up on the roof. It's been a busy day for me, too, but it isn't over yet. I still need to see the curtain go down on the year's longest day."

From the roof, they had an unrestricted view in all directions. They could look north across the river to the nation's capital, Washington, DC, and west across rolling woods. The Sun peeked through spaces in the quickly dispersing clouds. The day was nearing sunset.

"Dad, I've been thinking all day about the different lengths of daylight that are happening around the world today. Billy says the Sun has been up since the middle of May and won't set at all until August. Makindu reports nothing surprising about today, 12 hours of daylight followed by 12 hours of darkness, just like every other day. Justin gets only 8 hours of sunlight today, but Hiroko has a day just about the same as ours. It's pretty hard to figure out."

At that moment, the disk of the Sun touched the horizon. Wendy and her dad watched in silence until there was just one brilliant sliver remaining. "Going...going...gone," she whispered. "It must be 8:37 p.m."

As they started back down to their apartment, Wendy asked, "What causes days to get longer in some places, shorter in other places, and stay the same in still other places?"

"The answer to that question is also the key to understanding the seasons. Look for the answer not in what the Sun is doing, but what Earth is doing. You can shed a little light on the subject by looking closely at the revolution of Earth around the Sun and the rotation of Earth on its axis."

"Very funny, Dad, but thanks for the tip."

## Think Questions

1. Which locations have the greatest number of hours of daylight on June 21? The fewest hours of daylight?
2. Which locations have the longest hours of daylight on December 21? The shortest hours of daylight?
3. Alpena, Michigan, is located  $45^{\circ}$  north of the equator. How much daylight do you estimate they have on June 21? On December 21?
4. Boulder, Colorado, has a latitude of  $40^{\circ}\text{N}$ . Wellington, New Zealand, has a latitude of  $41^{\circ}\text{S}$ . Which city has the longest amount of daylight on June 21?