Wind Chill: Maurice Bluestein (a mechanical engineer) was shoveling snow one evening in 1994. It was -25ºF. The Weather Service, using an old formula, declared that it felt like it was -65ºF. This effective temperature would supposedly cause frostbite in 15 seconds. Dr. Bluestein was dubious. He didn't feel very cold. He had been outside for much longer than 15 seconds and had not frozen in place. In fact, with all the shoveling, he was hot. Several years later he came up with what we now use to determine the **W**ind **C**hill **T**emperatures.

$$\boldsymbol{WTC = 35.74 + 0.6215T - 35.75V^{0.16} + 0.4275TV^{0.16}}$$ [T = ºF, and V = wind speed (mph)]

Using the modern WCT formula, with a temperature is -25ºF,
what wind speed would result in a WCT of -65ºF?

Given T = -25ºF, and a modern WTC = -65ºF, what would be the wind speed? [Solve for V.] Show work.

Answer is $V \cong 44\ mph$. How do you get this answer?

A LIST OF THE PRIMARY LOG PROPERTIES.

1)	$x = b^y$	is the same as	$y = \log_b x$,	

2a)	$\log_b xy = \log_b x + \log_b y$
2b)	$\log_b \frac{x}{y} = \log_b x - \log_b y$
3)	$\log_B A = \frac{\log_c A}{\log_c B}$
4)	$C \log_b x = \log_b x^C$

And the annoying ones created by substitution.

$$\log_b b^y = y$$
$$b^{\log_b x} = x$$

$$\boldsymbol{WCT = 35.74 + 0.6215T - 35.75V^{0.16} + 0.4275TV^{0.16}}$$ [T = ºF, and V = wind speed (mph)]

Solve for V to get a general equation into which you can put any WCT and T.

Solve WCT equation for $V^{0.16}$. Then convert to $\log_V$. *Set that ugly fraction equal to x to be tidy. We'll convert back after we've done a bunch of algebraic moves. You avoid a lot of copying errors by doing this.*	$35.75V^{0.16} - 0.4275TV^{0.16} = 35.74 + 0.6215T - WCT$ $V^{0.16}(35.75 - 0.4275T) = 35.74 + 0.6215T - WCT$ $V^{0.16} = \frac{(35.74 + 0.6215T - WCT)}{(35.75 - 0.4275T)} = x$ $\log_v x = 0.16$
Employ log property 3 in order to free the V from the base in the logarithm.	$\log_v x = \frac{\log_{10} x}{\log_{10} V} = 0.16$

Do a little algebra to get the term with V out of the denominator.	$\log_{10} V = \frac{\log_{10} x}{0.16}$
Employ log property 1.	$V = 10^\wedge \left(\frac{\log_{10} x}{0.16}\right)$
Now evaluate x and $\log_{10} x$	$x = \frac{(35.74 + 0.6215T - WCT)}{(35.75 - 0.4275T)}$ $For\ T = -25\ and\ WCT = -65,$ $x = \frac{85.2025}{46.4375}\ \ and\ \log_{10} x \cong 0.2636$
Evaluate wind speed.	$V \cong 10^\wedge \left(\frac{0.2636}{0.16}\right) \cong 10^\wedge 1.6474 \cong 44.4\ mph$

Wind Chill Chart

Temperature (°F)

Wind (mph) / Calm	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
5	36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63
10	34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72
15	32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77
20	30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81
25	29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84
30	28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87
35	28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89
40	27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91
45	26	19	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93
50	26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95
55	25	18	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68	-75	-82	-89	-97
60	25	17	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69	-76	-84	-91	-98

Frostbite Times: 30 minutes, 10 minutes, 5 minutes

Wind Chill (°F) = 35.74 + 0.6215T - 35.75($V^{0.16}$) + 0.4275T($V^{0.16}$)

Where, T= Air Temperature (°F) V= Wind Speed (mph)

Effective 11/01/01

Caveat: Windchill temperature is defined only for temperatures at or below 10 °C (50 °F) and **wind** speeds above 4.8 kilometers per hour (3.0 mph).

$$\boldsymbol{WCT = 35.74 + 0.6215T - 35.75V^{0.16} + 0.4275TV^{0.16}}$$ [T = ºF, and V = wind speed (mph)]

Question: What sorts of WCTs do you get when you input Ts and Vs outside the boundaries of the model?

-Try V = 0 mph and any T. Shouldn't T = WCT? Why doesn't it?

-Try T = 100ºF and V = 100 mph.

-Can you set up the WCT equation in an Excel (or similar) spreadsheet? Create some graphs?

-Can you set up your equation for V as a function of WCT and T? Create some graphs?

-Dissect the WCT equation. What part of the WCT equation is the primary driver of the shape of your graph?