

Temperature Activities Using Davis Instruments

Middle School Lesson: Teacher's Notes

Part I: Monthly Average High and Low Temperatures

The student will use monthly high and low temperature averages to compare and contrast their site with others and be able to discuss how the averages affect our lives.

This activity requires the **average high temperature** and the **average low temperature** for *at least* one month. Students' **WeatherLink**[®] software used with systems such as **Vantage Pro2**[™] can create a *Monthly Climatological Summary* to provide the averages in chart form, with calculations completed.

WeatherLink software used with systems such as **Vantage Pro2** can create a graph, in which calculations needed for the activities are made by the students.

Purpose

The student will compare and contrast averages from their site with those from selected U.S. cities, make inferences about the climate, and draw conclusions by relating the data to everyday life.

Materials

1. Monthly Climatological Summary for as many months as possible (up to one year) for your station
or
Monthly or yearly graph showing average high and low temperatures for each month at your station *or*
Daily or weekly graphs from which student will calculate the *monthly* average high and low temperatures.
2. A copy of Climatic Data for Selected U.S. Cities.
3. Student Answer Sheet or teacher prepared answer sheet.

Procedure

1. Have students find the average high temperature and average low temperature for as many months as you have provided. Review "averaging" if necessary or refer students to averages already calculated.
2. Discuss the Climatic Data sheet with students. "High" and "Low" refer to the temperature *averages* for each of the five sites and are given for each of the 12 months.
3. Make sure that students note which month or months are available from your site. Comparisons and contrasts will be made by studying the *same months* from the five cities and your site.

Part II: Degree Days Using Monthly Average Temperatures

The following activity requires the degree-day information for your site for at least one month.

WeatherLink software used with systems such as **Vantage Pro2** can create a *Monthly Climatological Summary*, which provides the degree-day information calculated each day and totaled for the month.

WeatherLink software used with systems such as **Vantage Pro2** can create a graph, with the high and low temperatures for each day, so that the student can make the calculations.

Normal Degree Days

Heating degree days are used to estimate fuel consumption needed for heat. Heating days are calculated using **daily mean temperatures** (maximum temperature + minimum temperature divided by 2, rounded to the nearest whole degree). **One heating degree day** is accumulated for each degree that the daily mean temperature falls below the base temperature of **65°F**. The daily degree days are summed to determine the monthly values, which are then averaged over the 30-year period to establish the usual number of heating degree days. Therefore, locations that have large heating degree-day values use more fuel for heating than locations with small heating degree-day values.

Cooling degree days are used to estimate the amount of fuel needed for air conditioning or refrigeration. **One cooling degree day** is given for each degree that the daily mean temperature exceeds the base of **65°F**. The daily cooling degree days are summed to determine the monthly values, which are then averaged over the 30-year period to establish the usual number of cooling degree days. There, locations that have large cooling degree-day values use more fuel for air conditioning than locations with small degree-day values.

Purpose

The student will compare and contrast degree heating and cooling days from their site with those from selected U.S. cities, evaluate the data given and draw conclusions by relating the data to everyday life.

Materials

1. Monthly Climatological Summary for as many months as possible (up to 1 year) for your station
or
Monthly graph showing average temperature for each day, from which the degree heating or cooling day values can be determined (see above)
or
Daily or weekly graphs from which student will calculate the monthly average high and low temperatures
2. A copy of Degree-Day Data For Selected U.S. Cities
3. Student Answer Sheet or teacher-prepared answer sheet

Procedure

1. Give students background information concerning degree-day values and how they are calculated. Have students calculate at least one day from a sample problem.
2. Discuss the Degree-Day Data sheet with students. Again, “Heating” refers to the number of degrees that the daily mean temperature was below 65° F and “Cooling” refers to the number of degrees that the daily mean temperature was above 65° F. The values for the five cities are given for each of the months in the year.
3. Make sure that students note which month or months are available from your site. Your students will make comparisons and contrasts using data for the *same months* from the five cities and your site.

Average Temperatures around the Country

Use the average monthly high and low temperature from your site to compare them with data from other cities in the United States. By analyzing the data, you can draw some conclusions about your weather compared to other parts of the country and how we are affected by the weather.

Materials

1. Monthly high and low temperature averages from the Davis Instruments weather station at your site.
2. Climatic Data for Selected U.S. Cities

Procedure

Use the data of monthly high and low temperature averages from your site and others to complete the following questions and statements. Be as complete as possible in answering each one below.

1. According to the data from your site, what month(s) will you be comparing with other sites?

2. Which site (yours or a city) has the warmest high temperatures when comparing each month?

3. Which site has the coldest low temperatures when comparing each month?

4. Pick one month's data from your site (if you have more than one), and give the range between high and low temperatures for that month. How does this range compare with the range from the five cities for the same month?

5. Using the data collected from your site and any other information you have about your area, explain which of the five cities has weather most like yours. Be sure to give reasons for your choice.

6. Using your data, try to determine which site has the most comfortable weather year-round. Use 65° F as "comfortable" to compare highs and lows for each month given. If the average highs and lows are close to 65° F, less heating and air conditioning will be needed to make it "comfortable". Explain why you chose this site.

7. Would you consider your site “comfortable” during any part of the year? Explain. How does your data support this conclusion?

8. Knowing the average high and low temperatures for each month could be important in many occupations. Give three occupations that would benefit from having this data and explain why it would be important to them.

Climatic Data for Selected U.S. Cities

Phoenix, Arizona

	J	F	M	A	M	J	J	A	S	O	N	D
High	65.2	69.7	74.5	83.1	92.4	102.3	105	102.3	98.2	87.7	74.3	66.4
Low	39.4	42.5	46.7	53.0	61.5	70.6	79.5	77.5	70.9	59.1	46.3	40.2

International Falls, Minnesota

	J	F	M	A	M	J	J	A	S	O	N	D
High	11.1	19.5	32.0	49.1	63.9	73.3	78.5	75.4	64.1	52.8	32.9	17.8
Low	-11.0	-4.9	8.9	27.1	38.6	49.0	53.7	50.9	41.6	32.8	16.9	-1.4

Atlanta, Georgia

	J	F	M	A	M	J	J	A	S	O	N	D
High	51.2	55.3	63.2	73.2	79.8	85.6	87.9	87.6	82.3	72.9	62.6	54.1
Low	32.6	34.5	41.7	50.4	58.7	65.9	69.2	68.7	63.6	51.4	41.3	34.8

San Diego, California

	J	F	M	A	M	J	J	A	S	O	N	D
High	65.2	66.4	65.9	67.8	68.6	71.3	75.6	77.6	76.8	74.6	69.9	66.1
Low	48.4	50.3	52.1	54.5	58.2	61.2	64.9	66.8	65.1	60.3	53.6	48.7

Washington, D.C.

	J	F	M	A	M	J	J	A	S	O	N	D
High	42.9	45.9	55.0	67.1	75.9	84.0	87.9	86.4	80.1	68.1	57.4	46.6
Low	27.5	29.0	36.6	46.2	56.1	65.0	69.9	68.7	62.0	49.7	39.9	31.2

Average Degree Days around the Country

Use the daily mean temperatures or values given by your teacher to determine degree heating and degree cooling days for your site. A Degree Heating Day is added for each degree that the daily mean temperature is below 65° F (Ex.: If the daily mean temperature for Tuesday was 61°F, then we would record a degree heating day value of 4° F). Degree Heating Days are calculated to determine how much fuel is consumed in heating. A Degree Cooling Day is added for each degree that the daily mean temperature is above 65° F. (Ex.: If the daily mean temperature for Wednesday was 71° F, then we would record a degree cooling day value of 6° F). Degree Cooling Days are calculated to determine how much fuel is consumed in air conditioning or refrigerating.

Materials

1. Daily mean temperatures from the Davis Instruments weather station for each day of the month (from which to calculate the degree days for each month given) or degree days already calculated for each month.
2. Degree-Day Data for Selected U.S. Cities

Procedure

Use the degree days calculated for your site and the data given for the other sites to complete the following questions and statements. Be as complete as possible in answering each one below.

1. According to data from your site, which month(s) will you be comparing to other sites?

2. Which site (yours or a city) has the most degree heating days? In which month(s) did this occur?

3. What would the heating bill be like for a person living at this site (your answer to #2) compared to the other sites?

4. Which site has the most degree cooling days? In which month(s) did this occur?

5. What would the air conditioning bill be like for a person living at this site (your answer to #4) compared to other sites?

6. For the month(s) given for your site, how does your site compare to the other cities? Is your site similar or significantly different in numbers of degree days for heating or cooling from the others?

7. If you were looking for a place to live where heating and air conditioning bills might be the lowest (based on degree days), which site would you choose? Use the data given to explain your answer.

8. By using the degree days for each month, choose the site that might have the longest growing season for crops. Explain why you picked this site over the other ones.

9. By using the degree days for each month, choose the site that might have the longest growing season for crops. Explain why you picked this site over the other ones.

10. Knowing degree-day totals for these sites might affect the kinds of items available in local stores. Pick at least two sites and describe at least two items that would be needed by customers in that location based on the type of climate they appear to have. Explain why they might need these items.

Degree-Day Data for Selected U.S. Cities

Phoenix, Arizona

	J	F	M	A	M	J	J	A	S	O	N	D
Heating	394	269	187	52	0	0	0	0	0	13	159	368
Cooling	0	20	51	142	376	645	846	772	588	273	27	6

International Falls, Minnesota

	J	F	M	A	M	J	J	A	S	O	N	D
Heating	2012	1613	1380	804	439	155	67	116	366	688	1203	1761
Cooling	0	0	0	0	14	41	101	60	0	0	0	0

Atlanta, Georgia

	J	F	M	A	M	J	J	A	S	O	N	D
Heating	716	563	400	133	37	5	0	0	7	130	394	636
Cooling	0	0	12	37	170	329	422	409	247	44	0	0

San Diego, California

	J	F	M	A	M	J	J	A	S	O	N	D
Heating	258	196	193	124	71	40	5	0	7	32	118	240
Cooling	0	11	7	10	21	79	170	226	187	109	22	0

Washington, D.C.

	J	F	M	A	M	J	J	A	S	O	N	D
Heating	924	770	595	257	68	0	0	0	13	197	489	809
Cooling	0	0	0	8	99	285	431	391	196	20	0	0

Source: Climatic Averages and Extremes for U.S. Cities, May '91
National Climatic Data Center, Asheville, N.C.

Answer Key for Part I

1. Name of month(s) given by teacher.
2. Phoenix (unless your site is hotter).
3. International Falls (unless your site is colder).
4. **High-Low = range**; Ex.: For April, Phoenix = 30.1, International Falls = 22.0, Atlanta = 22.8, San Diego = 13.3, D.C. = 20.9; student should compare your site to ranges for one given month.
5. City most like your site might have: similar highs, similar lows, similar ranges, no extremes in highs or lows.
6. San Diego is closest to 65° most months; note that no months average 80° for highs and no months are lower than 48° for lows. Year-round, it wins the “comfortable” award out of this group, unless your site is more “comfortable”.
7. Farmer (affects planting time, dictates number of crops per year and types of crops); contractor/construction (affects time needed to finish a job, pouring concrete, painting); utility company (determines peak fuel consumption months; determines amounts of fuels needed). Many other examples exist; including areas of health, safety, transportation, sports, etc.

Answer Key for Part II

1. Name of month(s) given by teacher.
2. International Falls (unless your site has more); January.
3. The heating bill could be three times more if based on degree heating data (2012° below 65° in that month).
4. Phoenix (unless your site has more); July.
5. The cooling bill could be two or three times higher based on degree cooling data (846° above 65° in that month).
6. Compare your site by looking at the totals for each month to see if they are significantly higher or lower, or if they are similar to any of the sites.
7. San Diego has the closest number to 65° each month, unless your site is closer.
8. Phoenix has the fewest degree heating days and might have the longest growing season based on this data.
9. International Falls has the most degree heating days and has the shortest growing season based on this data.
10. Examples of sites and items could include: Phoenix (shorts, swimsuits, sunscreen, air conditioners); International Falls (snow shovels, thermal underwear, heaters, heavy-duty car batteries).