**Determining Temperature, Relative Humidity, Wind Speed, Wind Direction, and Cloud Cover and Type Lab**

*Adapted from the Vernier Activities appearing in Earth Science with Vernier Activities Book*

**If you live in a mid-latitude region, you may notice changes in temperature and relative humidity from season to season. Summers tend to be humid, while winters are drier.**

**Temperature**: a measure of the warmth or coldness of the air (kinetic energy of air molecules)

 *Instrument used to measure:* Thermometer

**Relative Humidity**: the amount of water vapor in the air, compared to the amount the air could hold if it was totally saturated at a given temperature

 *Instrument used to measure*: Hygrometer

**Atmospheric conditions change constantly and high and low pressure systems moving through regions may cause differing wind strengths and direction. Instruments can be used to determine wind speed and direction.**

**Wind Speed**: the rate at which air is moving horizontally at a specific location; can be measured by an average (wind speed) or an instantaneous value (gust)

 *Instrument used to measure*: Anemometer

**Wind Direction**: the direction FROM WHICH the wind is blowing (a wind coming from the east is an “easterly” wind)

 *Instrument used to measure*: Wind Vane + Compass

**Finally, different atmospheric conditions generate various cloud types, covering an approximate percentage of the sky. Clouds may or may not generate precipitation events and their height in the stratosphere varies.**

**Cloud type**: clouds are defined by their general appearance and level in the atmosphere

 *Instrument used to measure:* observation and sample diagrams of cloud types

 Basic cloud types and related prefixes often used:

*Cirrus:* curly or fibrous

 *Cumulus:* puffy and piled up

 *Status:* flat and/or layered

 *Cirro:* prefix for high clouds (above 20,000 feet)

 *Alto:* prefix for mid-level clouds (between 6,000-20,000 feet)

 *Nimbo:* prefix or suffix meaning a cloud that is producing precipitation

(Common names of clouds include: Cumulonimbus, cirrostratus, cirrus, cirrocumulus, altostratus, altocumulus, stratocumulus, cumulus, status)

**Cloud Cover***: the amount* of clouds in the sky, in percent (or fraction)

Categories of cloud cover:

*Clear:* the sky has no clouds (0%)

*Fair:* 1-10% of the sky is cloudy

*Mostly sunny:* 11-30% of the sky is cloudy

*Partly cloudy:* 31-60% of the sky is cloudy

*Mostly cloudy:* 61-80% of the sky is cloudy

*Broken*: 81-90% of the sky is cloudy

*Overcast:* 91-100% of the sky is cloudy

**OBJECTIVES**

In this experiment, you will:

* Use a Temperature Probe, Relative Humidity Sensor, and Anemometer to collect and analyze outdoor air temperature, relative humidity, and wind speed.
* Use a compass and wind vane to determine wind direction.
* Use a cloud type diagram to determine cloud type and observe the sky to estimate percentage of cloud cover.

**MATERIALS**

|  |  |
| --- | --- |
| TI-Nspire/Lab Cradle (with Data Quest) | Compass |
| Vernier Temperature Probe | Wind Flag/PomPoms |
| Vernier Relative Humidity SensorVernier Anemometer Sensor | Cloud Type Diagram |

**Pre-lab Questions**

1. Predict the following measurements prior to using your instruments (don’t forget your units!):
	1. **Temperature (in Fahrenheit): \_\_\_\_\_\_\_\_\_\_\_\_**
	2. **Relative Humidity (in %): \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

*(Hint: 100% humidity usually means there is some form of precipitation occurring)*

* 1. **Wind speed (in meters per second (m/s): \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**
	2. **Wind direction: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

*(Hint: North, Southeast, Northwest, West, etc…)*

* 1. **Cloud type(s): \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

*(Hint: use your descriptions in the introduction above)*

* 1. **Cloud cover (in %): \_\_\_\_\_\_\_\_\_\_\_\_**
1. Do these measurements indicate WEATHER or CLIMATE at your location? **\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**
2. What is the difference between weather and climate?

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**PROCEDURE**

1. Connect the temperature probe and the relative humidity to the TI-Nspire Lab Cradle in the USB ports.
2. Launch the Data Quest Program on the TI-Nspire.
3. Carry the TI-Nspire/TI-Nspire Lab Cradle apparatus, temperature probe, relative humidity sensor, anemometer, pompom, compass, cloud type diagram, and these instructions outside. (Remember to bring a pen/pencil to record data.) Choose a location and record the location in your data table; be as descriptive as possible. Stay within range of your instructor in case you have any questions!
4. Press the START/STOP button to start data collection. Record the time of day in the data table. Enter the time using a clock format of hour and AM or PM, for example 3:32PM.
5. Collect data for one minute, allowing the instrument to stabilize. You will start and stop the program and repeat these measurements after one minute for a total of three times. You should record the minimum, maximum, and average temperature and relative humidity readings in your data table.
6. Next, you will need to determine the wind direction that the wind is generally coming from.
7. To do this, you will need your compass and pompom.
8. To begin, orient yourself to the northern direction using your compass. Hold the compass flat on your palm. The compass will orient itself to magnetic north. Turn and face northward; to your right is the east, to your left, the west, and behind you is south.
9. You or a partner should now hold up the pompom for 2 minutes and record the wind direction (N, NE, E, SE, S, SW, W, NW) every 10 seconds for the 2-minute interval. Record this data in your data table. Repeat this process two more times, for a total of 3 trials (6 minutes total). Record all data in your table.
10. When you have completed the wind direction activity, you will need to determine which direction as observed the most often and write that down as the average direction of the wind.
11. Next, you will need to determine wind speed. To do so, you will use the anemometer sensor. You will need to disconnect the temperature and relative humidity probes. The anemometer will need to be connected to the TI-Nspire Lab Cradle in the USB ports.
12. You will need to hold the anemometer in the direction of wind flow that you determined in Step 10 above. Press the START/STOP button to start data collection. You will collect data for 5 minutes using the anemometer. At the end of the 5 minutes, record the minimum, maximum, and average wind speed value in meters/second (m/s) in your data table.
13. Finally, you will determine the cloud type and percentage of cloud cover. In order to determine the type of cloud cover, you will need to use the cloud type diagram. You will need to write the names of the types of clouds and then describe them in words beside the cloud (be as descriptive as possible). IF there are multiple cloud types visible, record this information in the data table.
14. In order to determine the percentage of cloud cover, you will estimate how much of the sky is covered by clouds. Do this by imagining that the sky is like a pie divided into 10 slices with the center of the pie is straight overhead (the zenith). Count the number of pie slices covered by clouds. Half of a slice covered by cloud equals 5% and a full slice equals 10%. (Ex. 3 pie slices are full of clouds, this would equal 30% cloud cover and be called *mostly sunny*:



30% cloud cover

Mostly Sunny

1. You will need to disconnect all probes from the to the TI-Nspire Lab Cradle’s USB ports

and close the Data Quest program on the TI-Nspire graphing calculator. If you saved any of your data files, please delete them from the calculator.

**WEATHER DATA TABLE**

**Temperature, Relative Humidity, Wind Speed, Wind Direction, Cloud Type, Cloud Cover**

**School: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Group Members: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**Time: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**TEMPERATURE AND RELATIVE HUMIDITY**

|  |  |  |  |
| --- | --- | --- | --- |
| **TEMPERATURE** | **Minimum (oF)** | **Maximum (oF)** | **Average (oF)** |
| Minute 1 |  |  |  |
| Minute 2 |  |  |  |
| Minute 3 |  |  |  |
| *Average* |  |  |  |
| **RELATIVE HUMIDITY** | **Minimum (%)** | **Maximum (%)** | **Average (%)** |
| Minute 1 |  |  |  |
| Minute 2 |  |  |  |
| Minute 3 |  |  |  |
| *Average* |  |  |  |

**WIND DIRECTION AND WIND SPEED**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **WIND DIRECTION** | **:10** | **:20** | **:30** | **:40** | **:50** | **:60** |
| 1st min |  |  |  |  |  |  |
| 2nd min |  |  |  |  |  |  |
| 3rd min |  |  |  |  |  |  |
| 4th min |  |  |  |  |  |  |
| 5th min |  |  |  |  |  |  |
| 6th min |  |  |  |  |  |  |

**Average Wind Direction: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

(Most *frequent* direction recorded in the table above)

|  |  |  |  |
| --- | --- | --- | --- |
| **WIND SPEED** | **Minimum (m/s)** | **Maximum (m/s)** | **Average (m/s)** |
| Wind Speed Measurement |  |  |  |
| Time at Measurement |  |  |  |

**CLOUD TYPE AND CLOUD COVERAGE**

**CLOUD TYPE**

|  |  |
| --- | --- |
| **Cloud Type Names** | **Detailed Description of Cloud** |
|  |  |
|  |  |
|  |  |
|  |  |
|  |  |

**CLOUD COVERAGE**

*Looking directly overhead, shade in areas of the pie chart below where you see clouds. Fill in the fraction of the pie filled with clouds and convert that to a percentage. Then, indicate the classification of cloud cover (Clear, Fair, Mostly sunny, Partly cloudy, Mostly cloudy, Broken*, *Overcast).*



**Fraction: / 10**

**Percentage: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_%**

**Classification of cloud cover:**

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

Approximately how long of a span of years do climatologists need to study trends in weather patterns to determine a region’s climate or changes in climate? Why can’t we just use the weather results from **one** day?

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Used from: http://apollo.lsc.vsc.edu/classes/met130/notes/chapter5/summary.html

