Appendix 1 – Assignment Guide Provided to Students for Weather Instrument Term Project

Weather Instrument Term Project: Build a Weather Instrument and Take Observations

GOAL: To develop a weather instrument, gain experience observing the weather, record your observations, and compare your observations with information you find on the internet.

YOUR TASKS (presented in more detail below)**:**

1. You will construct a weather instrument (mostly from materials you can find around your house).
2. You will create a numerical scale for your instrument.
3. You will observe your weather instrument for 5 days and *calibrate* your instrument (determine the accuracy of your instrument).
4. You will share your instrument in lab during the 10th week of the semester and receive feedback on how to improve your instrument.
5. You will make weather observations for another 5 consecutive days using your weather instrument, your five senses, and the internet.
6. You will enter your daily observations in a weather journal. Your journal will consist of >5 TYPED pages – one for each day – as well as a few of pages describing your weather instrument, how you constructed it, how you calibrated it, and how well it worked.

DUE DATES: You have TWO due dates you need to remember:

1) **[10th week of the semester]:** You must bring your weather instrument to lab, along with your initial calibration curve.
2) **[14th week of the semester]:** Reports are due (IN PRINT) in class.

While I encourage you to work with others in designing and troubleshooting instruments, you must MAKE YOUR OWN instrument. Likewise, your weather observations (and estimates) must be entirely your own.

1. CHOOSING AND CONSTRUCTING A WEATHER INSTRUMENT

There are many resources online with instructions for building your own simple weather instruments – many websites are geared toward kids, but that doesn't mean the instruments won't work! (And it probably also means that you can find a way to improve on them.) I will provide you with some sample websites, but you are not limited to these! Do some browsing – and utilize your own imagination.

You may choose among four types of instruments: **Barometer, Thermometer, Anemometer, and a Hygrometer.** You may also find online instructions for Rain and Snow Gauges and a Wind Vane. Consider these 'extra-credit' options – YOU WILL NOT RECEIVE CREDIT IF YOU ONLY CONSTRUCT A RAIN GAUGE AND/OR WIND VANE.

2. NUMERICAL SCALE and CALIBRATION

(Numerical Scale must be completed by the time you bring your instrument to lab class – ideally, you have also made an attempt at calibration)

After you build your instrument, you will need to ***construct a numerical scale*** and ***calibrate*** it. This will also involve determining if your instrument works and help ensure that your weather measurements are repeatable from one measurement to the next.

Background: In order for your observations to be scientific. They must have the following characteristics:

- They are quantitative (they have a numerical scale and units of measurement).
- They are standardized (observations are taken according to a standard frequency, timing, and placement of your instrument)
- They are repeatable (your instrument should consistently indicate the same value when you measure the same conditions in the atmosphere – wherever or whenever that is).

When you can satisfy all three of the above conditions, your weather instrument is calibrated. This will be the most difficult part of the assignment – and it probably won't work! But you will be graded on the quality of your efforts to create a scale and calibrate – and the quality of your observations.

What to do:

(a) Create a numerical scale: The way you do this may vary, depending on which instrument you choose to use. You need to test the range of temperatures, pressures, humidity, etc., that your instrument can detect. It will help to have an actual instrument nearby – or use campus weather conditions available online (realize that these may be different from your house!). You can use observations from the station nearest to you at http://www.weather.gov . Take a measurement (if you are using a homemade thermometer, for example, note the position of fluid in a tube) – then compare that with your instrumental measurement, or with data taken online. Place a mark on your instrument (if necessary) to create a numerical scale. Do this for several days, or in varying conditions to get a range of values with your instrument.

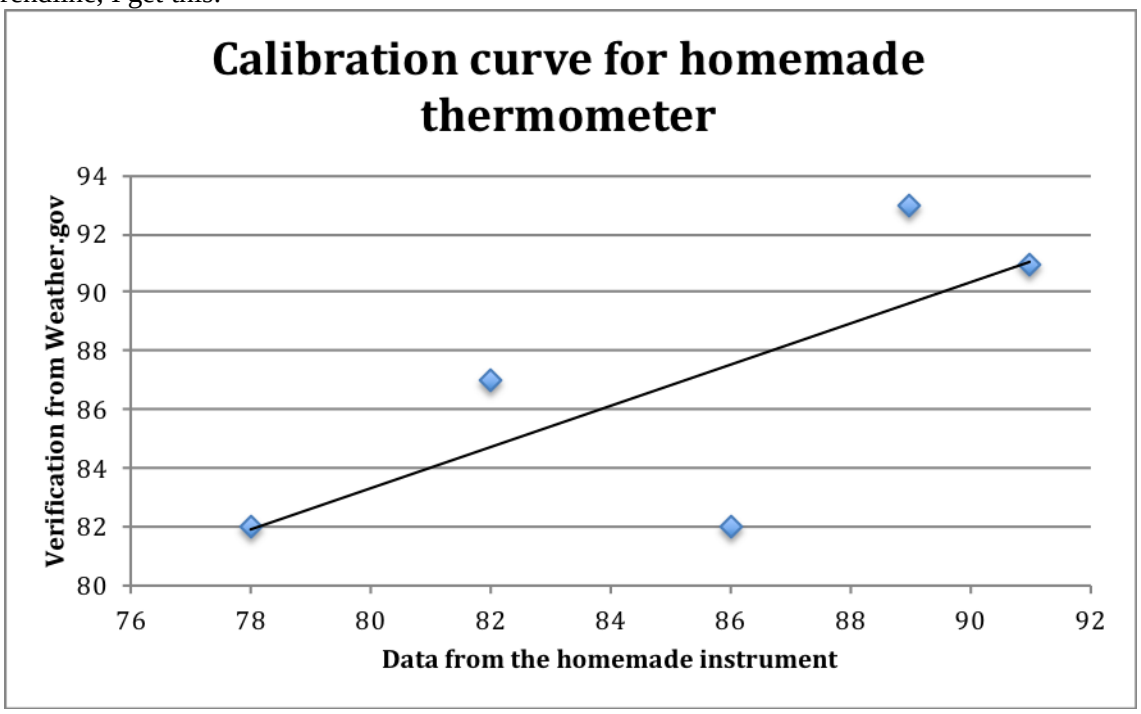
(b) Create a calibration curve: After you have created a numerical scale, take at least 5 observations over 5 days, and compare those with observations from the campus weather station or some other standardized weather instrument. Enter the observations from your instrument and the corresponding observations from the weather station (or some other verifying instrument) into an Excel Spreadsheet. Highlight the cells with your data, then insert an X-Y "scatter" chart. This allows you to see the relationship between the data from your instrument and those from the UNC station. Add a trendline to see if there is a numerical connection between the data. You can do this by clicking on a data point (to highlight all the data points, then from the 'Chart' menu at the top of your window, click 'Add a trendline.' If your data points fall within a line, your instrument is, at the very least, consistent in its measurements (if it's not actually measuring the values you see at the UNC website, at least it's consistently measuring above or below those values). If your data does not fall on or near the line, your instrument or measurement techniques are probably not consistent. (This is OK! As long as you explain why it may not be consistent when you submit your final project!)

EXAMPLE CALIBRATION CURVE

Imagine I've collected the following data from my homemade weather instrument, and compared the temperature to that on weather.gov on each day of my assignment:

Date	Temperature data from my own instrument	Verification from weather.gov
1-Sep	89	93
2-Sep	82	87
3-Sep	91	91
4-Sep	86	82
4-Sep	78	82

When I plot the temperature data from my own instrument against the verification and draw a trendline, I get this:



If my instrument were very consistent with the data from weather.gov, the points should all lie along the line. As it is, I will have to think about why my instrument is so inaccurate!

3. Bring your instrument to lab

In lab, you will get feedback on your instrument. After you've had some feedback on your instrument, you may need to do some redesigning. You will receive credit for bringing your instrument.

4. Extra Credit (20 points possible, maximum)

You can receive extra credit for building and discussing an additional instrument. You may receive up to 10 points for a wind vane or rain/snow gauge (note: you must describe the construction, use it in your observations, and evaluate its' performance). You can receive up to 20 points for another instrument that requires construction of a numerical scale and calibration.

GRADING: I will use the following rubric to grade your report.

Met 205: Weather Observing Report – Score Sheet
(90 points possible, 10 points for bringing your instrument to lab in Week 10)

	C- and below	B to C range	A to B range	SCORE
Introductory Paragraph (10 pts)	**0 to 5 points** __Introduction is very brief. __Introduction is poorly written. __Does not include instrument history, or history is very brief, no references cited.	**6 to 7 points** __Some attempt has been made to structure the introduction and give history. __Introduction is somewhat brief or somewhat unclear. __Reference cited.	**8 to 10 points** __Introduction is well-written. __Includes a concise overview of the project __Includes summary of the history of this instrument. __Reference cited	
Instrument Construction and Calibration (20 pts)	**0 to 11 points** __Instrument does not work, and there seem to be few, if any attempts to fix it. __Missing (or poorly done) numerical scale and/or calibration curve.	**12 to 15 points** __Instrument is carefully constructed and responds to changes in weather (or there have been many attempts to get it to work, and explanations provided as to why it doesn't work) __There is a numerical scale (or a good effort to make one) __The calibration curve is attempted but done incorrectly.	**16 to 20 points** __Instrument is carefully constructed and responds to changes (or, there is clear, detailed analysis of attempts to make it work, and explanations as to why it doesn't) __There is a clear numerical scale. __The calibration curve is done correctly.	
Daily Observations (20 pts)	**0 to 11 points** __Weather observations not included - or only a few included. __Missing some weather verifications. __Missing some descriptions of daily weather (or descriptions are brief and not very informative)	**12 to 15 points** __Missing some details in the observation or verification. __Attempt has been made to discuss daily weather (in the context of maps), but descriptions are brief and lack detail or analysis.	**16 to 20 points** __Weather estimates for each day include: Date, Time, Location, Wind direction, Wind speed, Temperature, Relative Humidity as well as a verification for Wind, Temp and Relative humidity, Cloud types and % covered reported each day along with any other conditions. __Daily weather changes are discussed clearly in connection with maps.	
Evaluation of Weather Instrument (25 pts)	**0 to 12 points** __Little discussion of instrument performance, or a description of performance is provided without analysis.	**13 to 19 points** __Discussion is very brief and could use more detail, but it is well written in general	**20 to 25 points** __Discussion of weather instrument performance is included, and provides a thorough, overall evaluation of the weather instrument	
Writing (15 pts)	**0 to 7 points** __Wording makes report difficult to follow. __Entries are disorganized.	**8 to 11 points** __There are a few grammatical problems that make it a bit hard to follow	**12 to 15 points** __Writing each day is clear, free of typos. __Table entries are well organized __Paragraphs well written.	
Extra Credit (20 pts max)		**Wind Vane or Rain Gauge only (with description of work) – up to 10 pts**	**Another instrument (not wind vane or rain gauge) was constructed, calibrated & evaluated – up to 20 pts**	