

Predicting the Weather: Big Data in Action

Lesson Plan for Grades 8-12

Length of Lesson: 1 hr 30min

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Subject area/course: Meteorology, Environmental/Climate Science

Materials:

1 worksheet per student

1 computer per pair of students

Large sheet of paper or poster board (optional)

TEKS/SEs:

- §112.20. Science, 8th grade (3A, 3B, 3C, 3D)
- §112.33. Astronomy, 9th-12th grade (2A, 2B)

Lesson objective(s):

Students will be able to:

- analyze, evaluate, and critique weather predictions using empirical evidence and logical reasoning
- utilize data models to predict weather
- identify advantages and limitations of models such as size, scale, properties, and variables
- relate the impact of meteorology research on the scientific and nonscientific communities
- define science and understand that it has limitations
- explain that hypothesis and predictions are tentative and testable statements that must be capable of being supported or not supported by observational evidence

Differentiation strategies to meet diverse learner needs:

- Search YouTube for videos of different languages similar to the linked videos, for ESL students
- Offer particular students private study projects if they have trouble collaborating with peers
- Offer particular students more challenging assignments such as analyzing the graphs for multiple variables or exploring to better understand how the analysis software works to manipulate all the data into a single accurate prediction.

ENGAGEMENT

- Teacher will show portions of weather forecasting film from the 1960's and modern weather forecasting videos to show progression in the field of meteorology ([see resources section](#))
- Discussion about instances when the weatherman or weatherwoman was wrong and many individuals of that area became very upset (i.e. when it was forecasted to be sunny on the 4th of July but it rained).
- Teacher leads mini lecture about using previous data and models to predict future events ([minute reference 6:45 – 8:58](#)). The example in the video shows many colored lines (various models) that predict the temperature for the weekend. The point where most of the lines accumulated on Monday (“Today”) is the most commonly predicted temperature, which was off of the actual temperature by 1°.
- Transition to “Weather Forecasting Activity” exploration by advising students to be in the shoes of the weatherman/weatherwoman

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EXPLORATION

- Students get into pairs to complete the “explore” section of the Weather Forecasting Activity
- As there are many counties in Oklahoma, each group will be pick 1 county to perform the forecasting exploration with ([see resources section](#))
- Groups will use the Mesonet Long-Term Averages- Maps ([see resources section](#)) to see the Air Temperature averages for various months of various years.
- Groups will graph the Air Temperature averages for the current month over the time period of 1999-Most Current Year.
- Using the data and graph, students will do their best predict the current month’s average air temperature (as it will not be officially released till the beginning of the next month).

EXPLANATION

- Teacher will explain that these predictive models are never certain and that their accuracy can only be determined once the time for which the prediction covered has passed.
- Teacher will lead discussion about some of the variables that are associated with air-temperature (i.e. pressure, wind patterns, solar radiation, humidity, etc...). Teacher can enhance discussion by asking questions such as “how did you come up with your prediction for this month’s air temperature average?” and “was it very obvious from that data what the average temperature could be for this month or did you wish you had some more information?”.

ELABORATION

- Students will repeat the “explore” activity but with a variable other than average air temperature (ex. Average minimum wind speed, etc...). Students can then overlay the two graphs (one for each of the variables measured) by adjusting the axes appropriately. From this new graph with two different functions, students can try to notice any relationship between the two variables (i.e. as lower air temperature increases air pressure also seems to increase).
- Next students are to go to the Mesonet data files ([see resources section](#)) simply to see the sheer magnitude of data that is recorded over a single day in the state of Oklahoma. Students are asked to imagine performing the task from the “explore” activity but in a way to include all of the data offered by the probes and sensors around the state.
- Students are then to understand the difference between **spacial** and **temporal** data by first looking up the definitions and then finding examples of each with regards to the “explore” activity. An example of spacial data would be the air temperature that is recorded across all of Oklahoma and in each country. An example of temporal data would be that air temperature is recorded every 5 minutes every day for years.

EVALUATION

- Students will complete a 3 question exit slip to properly assess their level of engagement and involvement with the activities/lesson
 1. List at least 3 of the many variables that effect weather (ex: air temperature).
 2. True or False: ‘Big Data’ records of past weather only exists in the state of Oklahoma.
 3. Do you believe that there will ever be a point in the future where meteorologists can predict the weather with 100% accuracy? Why or why not?

SOURCES AND RESOURCES

- Dr. Kevin Kloesel’s Hot Science – Cool Talks Lecture #92

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- <https://www.youtube.com/watch?v=ClntShKn5mk&feature=youtu.be>
- 1960's Weather Report video - https://www.youtube.com/watch?v=qY8rQJAJQ_4I
- 2014 Weather Report video - https://www.youtube.com/watch?v=s80vThS6_V0
- Students Ask: How Do Meteorologists Predict the Weather? - <http://www.gpb.org/blogs/talking-up-a-storm/2012/02/15/students-ask-how-do-meteorologists-predict-the-weather>
- Mesonet Main Webpage - <https://www.mesonet.org/index.php>
- Mesonet Long-Term Averages-Maps - https://www.mesonet.org/index.php/weather/mesonet_averages_maps
- County Map of Oklahoma - <http://www.worldatlas.com/webimage/countrys/namerica/usstates/counties/okcountymap.htm>
- Mesonet data files - https://www.mesonet.org/index.php/weather/mesonet_data_files

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EXPLORATION ACTIVITY or ACTIVITIES

Purpose:

Students are to use the “big data” offered by the Mesonet Oklahoma weather and climate records. By better understanding trends and patterns that have taken place in the past, students can better predict the future. With some of the structure and guidance offered by the activities, the role of weather forecaster can be one which students play as they apply their findings and understanding to predict next week’s weather. Groups/pairs of students will finally present their predictions to the class where they will be documented and compared to the actual weather results the following week.

Materials:

Computer (1 per student or pair of students)
1 student worksheet for each student
Additional scratch paper if needed

Safety Information:

Students should follow basic classroom safety protocol
Teachers may wish to take precautions and check for active safety settings on each internet device

Procedure:

Explore:

- Students get into pairs to complete the “explore” section of the Weather Forecasting Activity
- Each group will be pick or will be assigned 1 county to perform the forecasting exploration with ([see resources section](#))
- Groups will use the Mesonet Long-Term Averages- Maps ([see resources section](#)) to see the Air Temperature averages for various months of various years.
- Groups will graph the Air Temperature averages for the current month over the time period of 1999-Most Current Year.
- Using the data and graph, students will do their best predict the current month’s average air temperature (as it will not be officially released till the beginning of the next month).

Elaborate:

- Students will repeat the “explore” activity but with a variable other than average air temperature (ex. Average minimum wind speed, etc...). Students can then overlay the two graphs (one for each of the variables measured) by adjusting the axes appropriately. From this new graph with two different functions, students can try to notice any relationship between the two variables (i.e. as lower air temperature increases air pressure also seems to increase).
- Next students are to go to the Mesonet data files ([see resources section](#)) simply to see the sheer magnitude of data that is recorded over a single day in the state of Oklahoma. Students are asked to imagine performing the task from the “explore” activity but in a way to include all of the data offered by the probes and sensors around the state.
- Students are then to explore the difference between **spatial** and **temporal** data by first researching the terms and then finding examples of each with regards to the “explore” activity. An example of spatial

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data would be the air temperature that is recorded across all of Oklahoma and in each county. An example of temporal data would be that air temperature is recorded every 5 minutes every day for years.

The image below is the map of the state of Oklahoma with all its counties labeled



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TEACHER PAGE(S)

Explore:

You and a partner are going to analyze weather data to better understand what meteorologists often do to help accurately predict the weather. Your group will be given a specific county in the state of Oklahoma to conduct the study for as each county often has different data from neighboring counties.

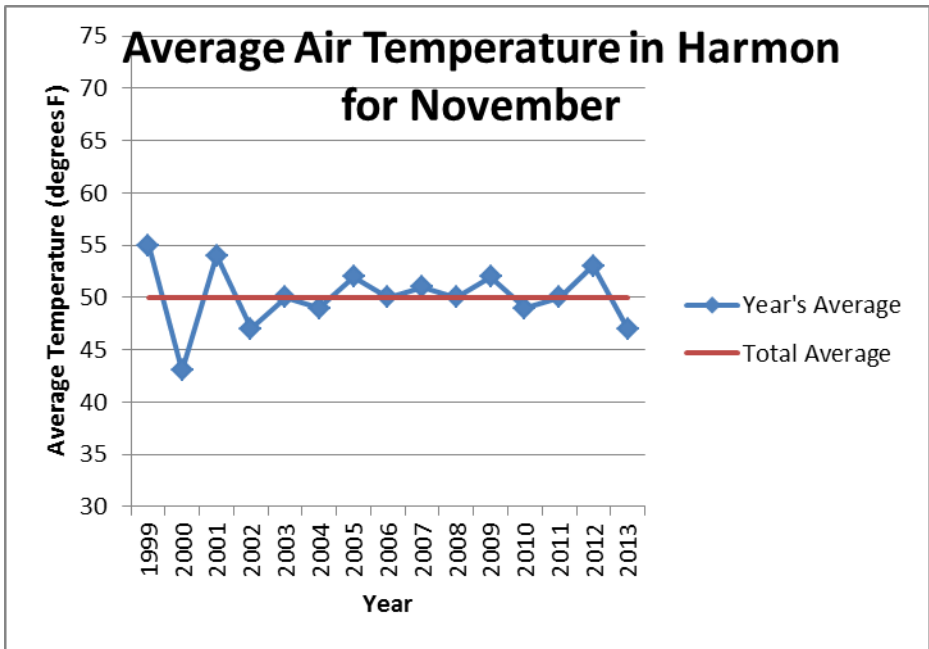
- Log onto your computer and enter the following URL :
https://www.mesonet.org/index.php/weather/mesonet_averages_maps
- Change the month menu so that it is the current month. By clicking on the product menu you will notice that there are many variables such as average wind speed and average dew point temperature. You will be choosing **average air temperature (in degrees Fahrenheit)** for this part of the activity.
- Note that the year ranges from 1999-last year rather than the current year. This is because you have selected the current month and the average air temperature for the month has not yet been released as the month is still not over. The goal of this activity is to predict what the average air temperature for the current month will be.
- Locate your county and toggle through all the years and record the average air temperatures. Then record the average air temperature for all the years combined.

County name: Harmon Current Month November Current Year 2014

Year	Average Air Temperature
1999	55
2000	43
2001	54
2002	47
2003	50
2004	49
2005	52
2006	50
2007	51
2008	50
2009	52
2010	49
2011	50
2012	53
2013	47

Average of all years: 50

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Next, you and your partner will plot the graph of your data with the year on the x-axis and the average temperature on the y-axis. Make sure to include a line to denote the value of the average air temperature for all years (horizontal line).

Make your best prediction for what the current month's average air temperature will be

46 degrees Fahrenheit

Elaborate:

Repeat the Explore activity but with a new variable.

Average Maximum Wind Speed Gust

Compare the two graphs and record some of the patterns/relationships that you observe

Ex. As average air temperature increases average air pressure also increases.

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Now, explore the difference between **spatial** and **temporal** data by first researching the terms and then finding examples of each with regards to the “explore” activity.

Spacial Data: data which is independent of a time variable but dependent on the magnitude of inputs. For example, the number of people throwing a coin into a fountain. Number can be small or large.

Temporal Data: data which is dependent upon time and less dependent on the magnitude of inputs. For example, the number of coins a person throws into a fountain over a period of a day (the rate of coins thrown).

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STUDENT PAGE(S)

Explore:

You and a partner are going to analyze weather data to better understand what meteorologists often do to help accurately predict the weather. Your group will be given a specific county in the state of Oklahoma to conduct the study for as each county often has different data from neighboring counties.

- Log onto your computer and enter the following URL :
https://www.mesonet.org/index.php/weather/mesonet_averages_maps
- Change the month menu so that it is the current month. By clicking on the product menu you will notice that there are many variables such as average wind speed and average dew point temperature. You will be choosing **average air temperature (in degrees Fahrenheit)** for this part of the activity.
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- Locate your county and toggle through all the years and record the average air temperatures. Then record the average air temperature for all the years combined.

County name: _____ Current Month _____ Current Year _____

Year	Average Air Temperature
1999	
2000	
2001	
2002	
2003	
2004	
2005	
2006	
2007	
2008	
2009	
2010	
2011	
2012	
2013	

Average of all years:

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Next, you and your partner will plot the graph of your data with the year on the x-axis and the average temperature on the y-axis. Make sure to include a line to denote the value of the average air temperature for all years (horizontal line).

Make your best prediction for what the current month's average air temperature will be. How did you get this answer?

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Elaborate:

Repeat the Explore activity but with a new variable _____

County name: _____ Current Month _____ Current Year _____

Year	
1999	
2000	
2001	
2002	
2003	
2004	
2005	
2006	
2007	
2008	
2009	
2010	
2011	
2012	
2013	

Average of all years:

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Compare the two graphs and record some of the patterns/relationships that you observe

Next, go to the Mesonet data files (https://www.mesonet.org/index.php/weather/mesonet_data_files) simply to see the sheer magnitude of data that is recorded over a single day in the state of Oklahoma. Imagine performing the task from the “explore” activity but in a way to include all of the data offered by the probes and sensors around the state.

Now, explore the difference between **spatial** and **temporal** data by first researching the terms and then finding examples of each with regards to the “explore” activity.
