Daily Plan		Instructor:	
Daily Topic:	Measuring and Analyzing Weather and Climate Data 2: Temperature		
Unit Title:	Weather and Climate in Our Lives		
Course:	8th Grade Physical Sciences		

Materials, Supplies, Equipment, References, and Other Resources:

Classroom computer/digital projector or Smart TV, PowerPoint slides, NASA Global Warming from 1880-2017 animation at https://climate.nasa.gov/climate_resources/139/graphic-global-warming-from-1880-to-2017/ Ocean Temperature Change from 1940-2016 animation at https://www.youtube.com/watch?v=WuIg96nYu4Q worksheets, I-Pads or computers, pencils, and rulers. Can add pre-painted artwork depicting weather as a weekly forecast and climate as weather over an extended amount of time, and temperature data charts for the area if computer access is limited. Temperature data for the area will be obtained from the NOAA Regional Climate Centers database at http://scacis.rcc-acis.org/

References:

Cheng et al. (2017). How ocean temperature has changed from 1940 to 2016. Retrieved from https://www.youtube.com/watch?v=WuIg96nYu4Q

National Aeronautics and Space Administration. *Graphic: Global warming from 1880 to 2017.* Retrieved from https://climate.nasa.gov/climate_resources/139/graphic-global-warming-from-1880-to-2017/

National Center for Atmospheric Research and UCAR Office of Programs. *What's the Difference Between Weather and Climate?* Retrieved from http://eo.ucar.edu/kids/green/what1.htm

National Oceanic and Atmospheric Administration Regional Climate Centers, *SC ACIS*. Retrieved from http://scacis.rcc-acis.org/

National Weather Service. *National Weather Service glossary.* Retrieved from http://w1.weather.gov/glossary/

Intended Outcomes

What do you want students to know (K), understand (U), and be able to do (D)?

AFNR Standards and Benchmarks:

Natural Resources and Environmental Services Systems

Standard III: Apply scientific principles to natural resource management activities.
Benchmark III-A: Apply scientific principles to natural resource management (Performance Standards 2 and 3).
Standard III: Apply scientific principles to natural resource management activities.
Benchmark III-C: Examine natural cycles and related phenomena to describe ecological concepts and principles (Performance Standard 8).
Standard VII: Apply scientific principles to environmental services. Benchmark VII-A: Apply meteorological knowledge to recognize

Next Generation Science Standards:

MS-ESS2-5: Collect data to provide evidence for how the motions and complex interactions of air masses results in changes in weather conditions. Emphasis on how air masses flow from regions of high pressure to low pressure causing weather (defined by temperature, pressure, humidity, precipitation, and wind) at a fixed location to change over time. Examples of data can be provided to students (temperature data from local weather stations, tables, graphs, weather maps, diagrams, and visualizations).
MS-ESS3-5: Ask questions to clarify evidence of the factors that have caused the rise in global temperatures over the past century. Examples of factors include human activities such as fossil fuel combustion and agricultural activity, and natural processes such as the decay of

weather systems and weather patterns (Performance Standard 2).	organic matter. Examples of evidence can include temperature data from local weather stations, tables, graphs, maps of global and regional temperatures, and visualizations.

Essential Question:	How do we measure temperature and what is the temperature trend in our area over the last 70 years?
Objective(s):	1. After viewing a PowerPoint slide and receiving weather and climate verbal prompts, students will be able to define climate and weather and correctly distinguish between 4 of 5 weather and climate examples. 2. After viewing two PowerPoint slides, students will be able to correctly give the functions of 6 of 9 common components of a weather station. 3. In pairs, and given instruction and access to an/a I-Pad or computer, students will be able to generate a **Temperature Graph** that allows them to determine the number of record minimum and maximum daily temperatures in a given year. 4. Given prior instruction about the scientific process and hypothesis writing, students will formulate and test their own hypothesis for the temperature trend in their geographic area over the last 70 years by finding and graphing seven 10-year annual temperature means. (hypothesis written in the if/then/because format) 5. Given the weather and climate, weather station, and online temperature instruction and the learning activities presented in this lesson. Students will score at least a 4 out of 6 on two science knowledge, science skills, and reasoning ability multiple choice questions for this lesson that are on the unit test. **Learning Strategies Used:** Lecture and discussion, group work, accessing and analyzing temperature data for weather and climate from a local active weather station reporting on the NOAA Regional Climate Centers database, writing a climate related temperature hypothesis and conclusion statements, graphing data, and reading. Learning is differentiated through a variety of activities and exercises. **Literacy:** Understanding components and functions of common components of weather stations, following instructions on the worksheet for three NOAA Regional Climate Centers database searches, and writing a hypothesis and conclusion statements.

Activating Strategy **Preflection/Introduction (Interest Approach)** *How will you prepare students for what you want them to learn today and link today's activities with previous classes?*	**Estimated Time:**	**10-15 Minutes**
1. Have students complete Activity 1 of their worksheets on examples of weather and climate (See attached temperature worksheet) as a review and warm-up. 2. We've learned how scientists measure and report a very important part of weather and climate, precipitation, and how we can access precipitation data locally or in other places in the country using the NOAA Regional Climate Centers database. Today we will explore how another important part of weather and climate, temperature, is measured and reported. We will also explore temperature trends both globally and locally. 3. Show the two weather station PowerPoint slides one more time with an emphasis on how we measure temperature on land and on the ocean (NOAA weather buoy picture in the next slide). Make		

a note that these weather stations are on land and sea all over the planet, constantly remote transmitting their data to satellites and then to computer servers. Weather and climate scientists around the world collaborate to analyze and make sense of the weather and climate data these stations are transmitting.

4. From the PowerPoint slide that contains the hyperlink to the NASA Global Warming from 1880 to 2017 animation at: https://climate.nasa.gov/climate_resources/139/graphic-global-warming-from-1880-to-2017/

Show the animation twice and ask the students what the global air temperature trend has been from 1880 to 2017? All but a few small areas of the planet have warmed during this time and warming has increased during the last 30 years. In the 136 years that scientists have collected and summarized world temperature data, 17 of the warmest years have occurred since 2001! 2016 was the warmest year on record for the planet. The planet has warmed about .8 to 9 ºC or 1.4 to 1.6 ºF since 1940.
5. From the PowerPoint slide that contains the hyperlink to the How Ocean Temperature Has Changed from 1940 to 2016 animation at: https://www.youtube.com/watch?v=WuIg96nYu4Q

Show the animation twice and ask the students what the global ocean temperature trend has been from 1940 to 2016? Ocean surface temperatures have actually gone up by about .13 ºF per decade over the last 100 years and .9 ºF above the 1971 to 2000 ocean temperature average from 1979 to today (show the graph in Slide 15 of this presentation again). Our oceans absorb about 90% of the excess heat caused by the intensifying greenhouse effect. Review some of the consequences of global sea surface temperature increase articulated in Slide 15.

<table>
<tr><th colspan="2">Learning Approach 1</th><th>Estimated Time:</th><th>15-25 minutes</th></tr>
<tr><th>Teaching Strategy / Materials</th><th colspan="3">Brief Content Outline</th></tr>
<tr><td rowspan="2">Activities 2 and 3 on the Temperature Worksheet for pairs of students

Worksheets, student I-Pads or computers, classroom computer/digital projector or Smart TV</td><td colspan="3">K: What do you want students to know (facts, figures, vocabulary, etc.)?
1. To access and use the NOAA Regional Climate Centers database. Note: Teachers are recommended to try all of the NOAA Regional Climate Centers database protocols listed in the worksheet in advance of teaching this lesson so they can better assist the students. Exploring other analyses is also recommended so teachers become aware of other features of the database, especially if they plan to have students design an inquiry of their own that goes beyond the three in the worksheet.</td></tr>
<tr><td colspan="3">U: What do you want students to understand (what is the big picture)?
1. How to find local temperature data for a given day using the Daily Data Listing function. (example of measuring and reporting a day's weather)

2. How to use the Temperature Graph function to develop a graph that will allow students to determine the number of record minimum and maximum daily temperatures that were reached locally in a completed year of interest like 2018. This result might be an indicator of what is going on with temperature in the area, but because it is only for one year, it can't yet be called a climate trend (it is more of an example of measuring and reporting a year's weather). View the 2018 Temperature Graph Example for the Las Vegas, New</td></tr>
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	Mexico Municipal Airport that is included with this lesson to see what this graph looks like and communicates.
	D: What do you want students to be able to do (tasks, skills, etc.)? 1. Pairs of students on their I-Pad or computer will be guided by the teacher to enter the URL for the NOAA Regional Climate Centers database (http://scacis.rcc-acis.org/) and follow the teacher who is on the classroom computer/digital projector or Smart TV and demonstrating the Activity 2 and 3 search protocols. The teacher can use last Saturday for the Activity 2 protocol and then help them make the right choices and interpret the graph generated from the Activity 3 protocol. Students will answer the Activity 2 and 3 questions on the worksheet. 2. This part of the lesson can be enhanced by having the students generate their own temperature search protocols for other **Single-Station Products** and share their findings with the class. 3. If only a classroom computer/digital projector or Smart TV are available to the class, students can watch as the teacher, or a student with teacher assistance, navigates through the two search protocols and then answer the Activity 2 and 3 questions on the worksheet.

Learning Approach 2	**Estimated Time:**	**15-25 Minutes**
Teaching Strategy / Materials	**Brief Content Outline**	
Activities 4, 5, and 6 on the Precipitation Worksheet for pairs of students Worksheets, I-Pads or computers, pencil and ruler, classroom computer/digital projector or Smart TV	*K: What do you want students to know (facts, figures, vocabulary, etc.)?* 1. To formulate and test a long-term local (climate related) temperature trend hypothesis using data from a local active weather station reporting on the NOAA Regional Climate Centers database.	
	U: What do you want students to understand (what is the big picture)? 1. How to use the **Monthly Summarized Data** function for the NOAA Regional Climate Centers database to determine the local area temperature trend over the last 70 years (e.g., 1949-2018). (example of measuring and reporting an aspect of climate)	
	D: What do you want students to be able to do (tasks, skills, etc.)? 1. Pairs of students will develop their hypothesis on whether it has gotten warmer, cooler, temperature has gone up and down or down and up, or temperature has not changed at a local active weather station reporting over the last 70 years following the criteria specified on the worksheet (Activity 4 on the worksheet). 2. Pairs of students on their I-Pad or computer will be guided by the teacher to enter the URL for the NOAA Regional Climate Centers database (http://scacis.rcc-acis.org/) and follow the teacher who is on the classroom computer/digital projector or Smart TV demonstrating the Activity 5 search protocol. The teacher can help them make the right choices for the Activity 5 protocol and enter into the data table the	

	correct average yearly temperature figures for each of the seven 10-year periods. If the class gets too spread out on this activity, the teacher can give the final answers for the data table if each pair has at least found three of the seven 10-year annual averages. 3. While helping the students to find the average yearly temperatures for each 10-year period, the teacher can also point out other data in the tables. View the 2009-2018 Example of Average Monthly/Yearly Temperatures Table for the Las Vegas, New Mexico Municipal Airport that is included with this lesson to see what data the table reports. The 10-year yearly average precipitation is circled in pen. 4. The students can look at the averages in the data table and answer if their hypothesis is correct or incorrect why they can tell this. 5. For a more visual representation of the data and practice in graphing, follow the graph template example for this lesson to develop your own template master with a Y axis temperature scale that allows all of the local 10-year temperature averages to fit and an X axis for your 10-year periods of interest, and have the students enter their data points and connect the dots between 10-year periods to see the local temperature trend (Activity 6). You can also have the students design their own graph templates before entering their data. Activity 6 can be done before having the students write conclusions about their hypotheses. 6. This part of the lesson (Activities 4, 5, and 6 on the worksheet) can be enhanced by having the students generate their own hypotheses and temperature search protocols for other **Single-Station Products** and share their findings with the class. 7. If only a classroom computer/digital projector or Smart TV are available to the class, students can watch as the teacher, or a student with teacher assistance, navigates through the search protocol and then complete their data tables together.

Summarizing Strategy (Reflection) *How will you have students reflect on what they have learned today and prepare them for the next class?*	**Estimated Time:**	**10 Minutes**
After students complete their data tables, graphs, and conclusion statements based on their original hypothesis, discuss with the class the results from the Hypothesis Testing and Graphing parts of the worksheet (Activities 5 and 6). Has it gotten warmer, cooler, temperature has gone up and down or down and up, or temperature has not changed at our local active weather station over the last 70 years? Why?		

Assessing Strategy (Evaluation) *How will you determine if students know (K), understand (U), and can do (D) what you intended?*
Students will be able to differentiate between climate and weather and identify and give the functions of common components of weather stations. They will be able to conduct three protocols in the NOAA Regional Climate Centers database. They will be able formulate and test a temperature trend (climate) hypothesis and develop a graph of their data. Two science

knowledge, two science skills, and two science reasoning multiple choice questions are on the unit test for this lesson. (See unit test)